The FOUNDRY

Volume 56
Number 15

Published
Semimonthly

CLEVELAND, OHIO, AUGUST 1, 1928

Castings Receive Deposits When the Bank Is Closed

THE daily bustle occasioned by attempts to get to the bank before closing time is a familiar scene to owners and managers of mercantile establishments. Few companies care to risk retaining the daily receipts from the sale of merchandise in their own safes, so that as much of the money as possible is deposited in the bank. Of course the money collected

Courtesy Copper & Brass Research Association

The Depositor Places the Money Bag in a Container in the Outside Wall of the Building, and it Drops Through a Chute into the Bank Safe

from the time that the bank closes until the merchant shuts up shop must be held at the risk of loss from burglary or robbery. However, many banks now have installed night deposit safes, which make it possible for them to offer the depositor 24 hour service. When a bank is equipped with a night deposit safe, the depositor locks his money in a heavy canvas bag, opens the door of the safe, located on the outside of the building, places the bag in a receptacle and closes and locks the door. As the door closes, the bag of money slides down a chute into the safe of the bank. Much of the material used in the construction of night depositories is produced in the foundry, including the heavy bronze door and the bronze frame which are installed on the outside of the bank.

Find Where Castings Can Be Sold.

CONTENTS

FEATURE ARTICLES

Page

Pipe Foundry Operates on 24 Hour Schedule—By Frank G. Steinebach 606
Advancements in Cast Iron Quality Show Definite Progress—By Edward E. Marbaker 613
Core Making Is Mixture of Sand, Binder and Brains—By O. W. Potter 616
Specializes in Bronze Bearings—By Pat Dwyer 620
Cast Iron Is Improving—Part III—By Edwin Bremer 625
Base Bonus on Scrap Control—By R. J. Teetor 627
Bill Touches on Some Problems in Molding—By Pat Dwyer 629
Mounting a Cover Pattern—By H. N. Tuttle 632
Cleaning Room Progress Aids Production of Quality Castings—By Frank G. Steinebach 636
Committee Reports Progress on Coke Specifications—By W. A. Selwig 638
Identify Impurities by Simple Tests—By T. G. Bamford 640

REGULAR DEPARTMENTS

How and Why in Brass Founding — By Charles Vickers 624
Metals and Melting 635
The Shakeout 642
Trade Trends in Tabloid 643
Personal 644
What the Foundries Are Doing 648

—⊡—

PUBLISHED BY THE PENTON PUBLISHING CO., CLEVELAND, O.
BRANCH OFFICES

CHICAGO ..... 1147 Peoples Gas Bldg.
CINCINNATI ..... 209 Edwards Bldg.
NEW YORK ..... 2203-2206 No. 220 Broadway
PITTSBURGH ..... 2148-49 Oliver Bldg.
SAN FRANCISCO ..... 24 California Street
WASHINGTON, D. C. ..... 1653 Pennsylvania Avenue
BIRMINGHAM, ENGLAND ..... Prince's Chambers
LONDON, ENGLAND ..... 416-417 Caxton House, Westminster, S. W. 1
PARIS, FRANCE ..... No. 9 Rue de Londres
BERLIN, GERMANY ..... Wilhelmstrasse 114, Berlin SW, 48

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico ..... $3.00 a year
Canada ..... $4.00 a year
Great Britain and other Foreign Countries ..... £1:0:0 a year
Single copies ..... 25 cents

Copies published three months or more previous to date of current issue, 50 cents each

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified paid subscribers, and honest advertising of dependable products

Copyright 1928 by the Penton Publishing Co.

PIPE

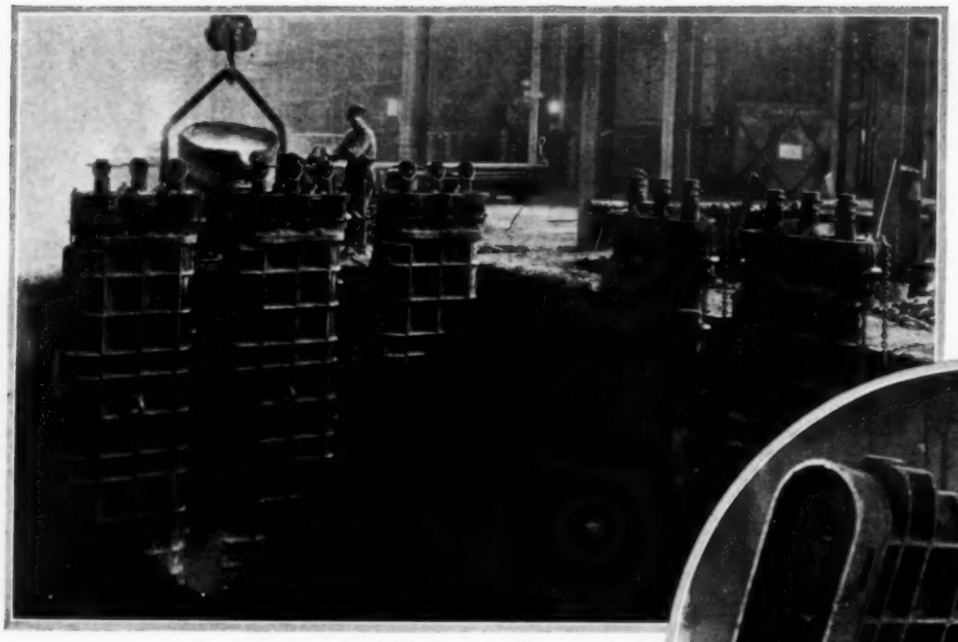


Fig. 1 (Left)—Flasks Are Placed in a Special Pit Where the Molds Are Poured One at a Time. Fig. 2 (Below)—After the Pipe Has Cooled, the Flasks Containing the Sand and Pipe Are Taken to the Shakeout

THE entire structure of modern civilization has been erected upon a foundation made up of products of the foundry industry. Castings form the basis of practically every convenience cherished alike by the city dweller and by those residing in the rural sections of the country. Without castings, families living in the densely populated sections would be without light, heat, water and power in their present forms. The farmer would be unable to obtain easily these essentials, and in addition would be without implements to cultivate his land and without the present rapid means of transporting his crops to market. In fact, if castings were eliminated entirely from our modern life, civilization undoubtedly would step backward several centuries.

Prominence of the foundry industry in the advancement of mankind has not been an overnight development. Years of study and experimental work by that great body of men who have the welfare of the industry in their hearts and the romance of iron in their souls, have been responsible for the present status of the industry. The demand for better castings, in greater tonnages and at lower costs, has resulted in the introduction and development of quantity production methods in many types of plants in the foundry industry.

In the minds of many, foundries producing castings for automobiles are associated most closely with the idea of mass production, chiefly because of the pioneer work that has been done in that field, and the publicity which has been given production methods by the automotive industry. However, readers of technical and business papers are acquainted with the progress that has been made in other classes of foundries, including those engaged in the manufacture of radiators, stoves, car wheels, agricultural implements and pipe.

Developments of major importance have taken place in foundries producing cast iron pipe, one of the foundry products so essential in our modern civilization. Changes in the design of pipe producing shops and advancements in equipment employed, greatly have increased plant capacities and have made quantity production possible. A most interesting application of quantity production methods in a cast-iron pipe shop is found at the Coshocton, O., plant of James B. Clow & Sons, Chicago, where an exacting schedule has been adopted to govern every operation in the production of pipe in sand molds.

The Coshocton plant produces only the 6 and 8-inch pipe, although it is posible that 3 and 4-inch pipe may be made at that plant later. At present the two smaller sizes and all pipe above 8-inch are cast at the plant of James B. Clow & Sons at Newcomerstown, O., a small town located about 17 miles from Coshocton. Pipe fittings and other miscellaneous castings required also are pro-

E FOUNDRY OPERATES *on* 24 Hour Schedule

By Frank G. Steinebach

duced in the foundry of the Coshocton plant.

Before describing in detail the various operations followed at the Coshocton plant in producing pipe, it will be interesting to sketch briefly the outstanding features of the operating schedule. The plant is in operation 24 hours a day, and with the exception of the cleaning department, practically the same number of men are required for each 8-hour shift. A complete cycle of operations is performed every half hour during each of the three shifts. In other words, during a half hour period, five flasks are filled and placed on the dryer, five flasks containing dry molds are taken from the dryer and placed at the pouring station, where the cores are set and the molds are poured; these five flasks are taken to the shakeout pit where they are cooled for 30 minutes and the five flasks from the previous pouring are shaken out and the pipe dispatched to the cleaning and finishing department. Every half hour the crane brings a ladle of molten metal from the cupola and during the same period, 15 pipe leave the foundry. Working on this schedule, 155 tons of pipe are produced every 24 hours, and on a six flask per half hour schedule, 200 tons are produced. The difference in the number of flasks poured and the number of pipe leaving the foundry is accounted for by the

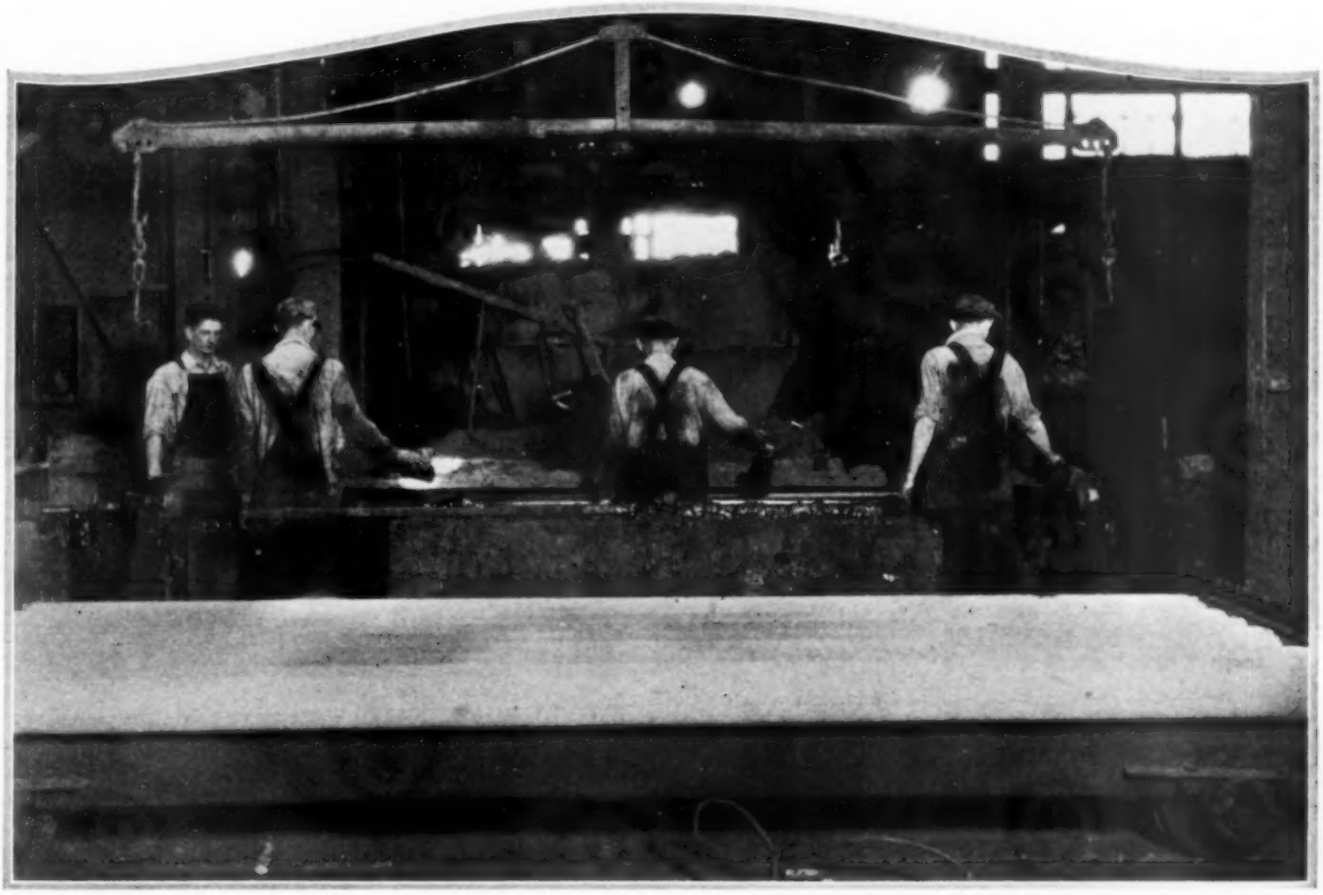


Fig. 3—After the Second Coat of Loam Has Been Applied to the Core, Blacking Is Spread Evenly Over the Surface of the Core

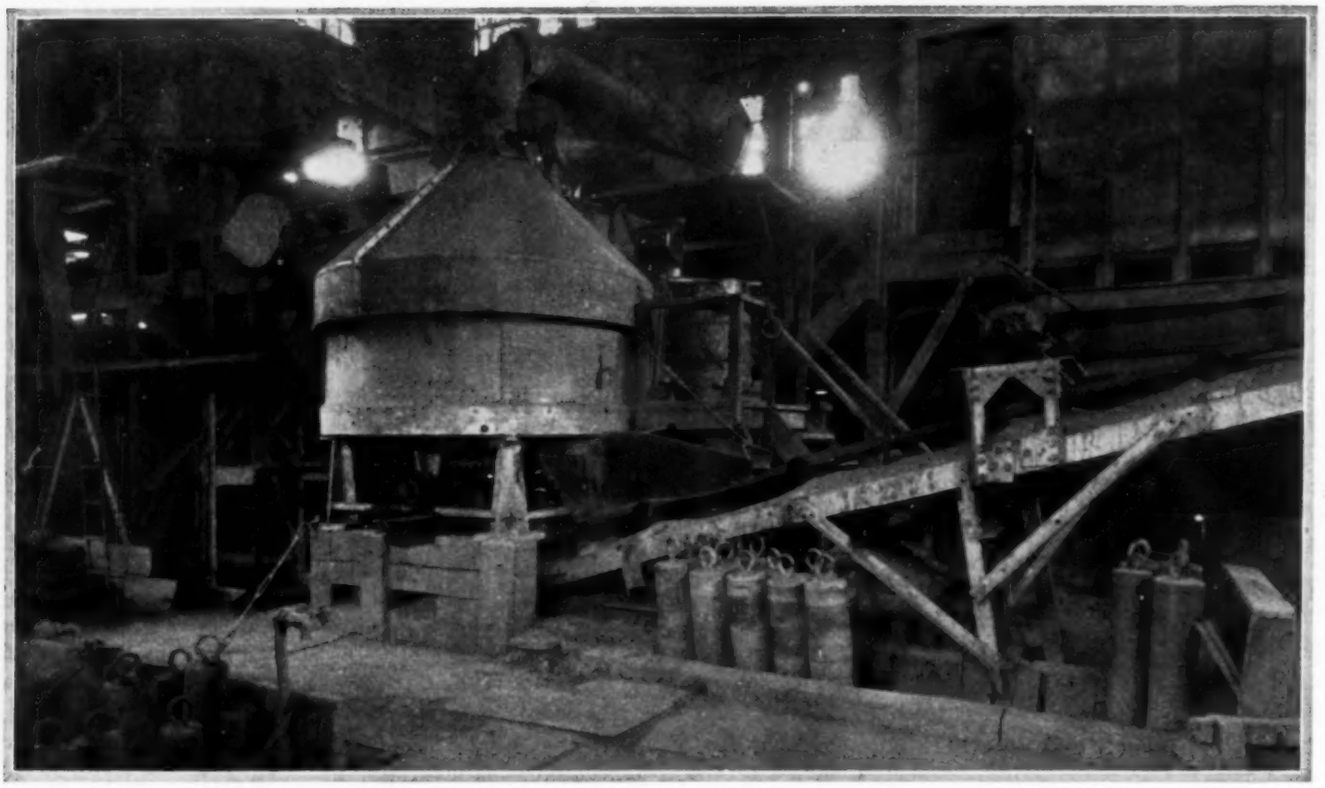


Fig. 4—Conveyors Carry the Sand from the Shakeout to a Muller Type Mixer Where Claywash Is Added and the Sand Prepared for Molding

fact that each flask contains three pipe molds.

When the continuous molding, drying, pouring and shakeout schedule first was adopted, some difficulty was encountered in timing the various operations. However, after several months of study and experimental work, each step in the operating cycle is completed with clock-like precision. With what seems like an exceedingly small number of men, considering the tonnage produced, this plant continues to turn out exceptionally good pipe, with delays few and far between. Considerable flexibility has been secured in the operating cycle, since it is possible to produce six flasks in every half hour period, but since the plant was operating on a schedule of five flasks or 15 pipe every 30 minutes at the time the material for this article was secured, the description will be confined to a production cycle handling five flasks each half hour. However, it is interesting to note that an additional crane is practically the only equipment necessary to increase from five to six flasks or from 15 to 18 pipe every half hour.

Both the pipe foundry and the fittings shop are located in one building, which is about 125 x 1000 feet. The pipe shop is at the north end of the building, with the dryers, pouring and shakeout pits in the center, the sand preparing equipment and the molding station in the west bay and the core making machines and the drying ovens in the east bay. The cupolas are located between the pipe and the fittings shops.

Heavy cast-iron flasks, one of which is shown in Fig. 2 are used in the pipe shop. These flasks are hinged on one side, as may be noted along the top of the flask shown in the illustration, and when in use they are clamped by steel clamps on the opposite side from the hinges. Four hinges and seven clamps hold the two halves of the flask securely during the molding, drying and pouring operations. The stool or chill plate shown in Fig. 2, is bolted securely to one half of the flask and is carried to the various operations including the shakeout.

Car Carries Flasks

To present a clear idea of the many operations performed in casting the pipe, the various steps from molding to shakeout will be described in detail. An empty flask, which has the open side clamped, is picked up by a crane and placed on a special run-out car in the bottom of the pit near the molding station. This car carries the empty flask to the molding station and returns the completed mold to the pit where it may be picked up by the overhead crane. The two run-out cars and two sets of patterns are used so that one mold is finished, as shown at the left in Fig. 6, while the second mold is being rammed, as illustrated at the right in Fig. 6.

Molds are rammed with pneumatic rammers made by the Chicago Pneumatic Tool Co., Chicago. When the empty flask is in position, the three patterns are lowered into place by a crane which serves the molding floor. A small amount of specially prepared sand, which has an extra amount of bond, is thrown into the flask and rammed. This special sand forms the bead end of the pipe. Sand then is shoveled into the flask from the pan, which is shown in Fig. 6, and the ramming proceeds as the flask is filled to within approximately 14 inches of the top. The head pattern then is dropped into the mold and the head is rammed by hand, as shown at the right in Fig. 6.

An aluminum pattern is used for the head on the 8-inch pipe and a cast-iron pattern for the head on the 6-inch size. It was found through experiment that a cast-iron pattern for the 8-inch pipe was too heavy for the molder to handle and that an aluminum pattern for the 6-inch size was too light to pack the sand properly around the bottom of the pattern as it was dropped into the flask. After ramming, the top of the mold is hardened by being treated with glutrin water. The molding crew rams between 8 and 9 tons of sand an hour.

When the mold is complete, the pipe

patterns are drawn by the crane, the head pattern acting as a guide for the main pipe pattern. The head pattern then is removed and the car with the mold is run out into the main pit, a distance of approximately 12 feet. The mold then is picked up by a crane and set on a blacking platform at one side of the molding station. The three molds in the flask then are stamped and numbered and a mixture of plumbago and molasses water is applied to the bell end of the mold. A dasher is placed near the top of the mold and the blacking is dumped in the mold. The dasher causes the blacking to be distributed over the entire mold surface. Care is taken to prevent the blacking from splashing into the molds already blacked. The blacking platform has a number of slots through which the excess blacking flows into a tank below. The blacking which enters the tank, is carried pneumatically to a tank on the foundry floor above for further use. Each shift has a separate tank for the blacking and each man makes up the mixture for his next shift before leaving the plant at the close of the eight-hour period, taking care to maintain a specific gravity of approximately 1.30.

Since an uneven distribution of the blacking on the face of the mold might cause a bad casting, the molds are inspected carefully after applying the blacking mixture. A workman in the pit holds a torch under the stool, which throws a light on the surface of the mold and permits the workman on the foundry floor to check the distribution of the blacking on the mold surface and also to see if the mold is defective in any way. In case any defects are found, the mold is shaken out.

If the mold passes the inspection it is taken to the dryers by one of the two cranes which serve the bay. The drying pit, located in the center bay at one end of the foundry building, has a capacity of 96 flasks. Platforms, even with the foundry floor level, and extending about three-quarters of the distance across the pit, divide the drying pit into four sections, each having equipment for 24 flasks.

Have Auxiliary Heating Unit

Heat for drying the molds is supplied by furnaces located in a special pit at the end of the building. This pit has two complete units, composed of furnaces and fans, one unit being held as a spare. Four furnaces, which are built in a row, have a large flue chamber constructed in the rear. Products of combustion, and a predetermined amount of air which enters through a damper at the end of the flue chamber, are sucked by a large fan and then forced through a series of flue pipes to the drying pits. In addition the fan on the auxiliary unit is operated at a slow speed to force an additional amount of cold air into the system. The fans have water cooled bearings and shafts, and practically no trouble is encountered with that equipment.

Furnaces are fired with soft coal, which is purchased from small mines near the plant and hauled from the mines in wagons. As soon as possible after firing the furnace, the fire door is opened to secure a more complete combustion of the coal and gases. A recording pyrometer indicates the temperature of the gases entering the molds, and great care is exercised to maintain an even temperature.

The main flue from the fan extends the full length of the drying pit. Eight flue pipes lead from the main pipe to the various lines of platforms which support the molds. After the molds are placed over the 12 slotted platforms in one line, a damper is opened by a chain from the foundry floor level and the products of combustion pass through the pipe leading from the main flue to the platforms, through the openings in the platform and up through the molds. If it is not desirable to wait until 12 molds have been placed on one line of platforms, the empty slots may be covered. With the system running on the present schedule, the molds may remain on the dryers 8 hours. However, from 4 to 5 hours

Fig. 5—Fittings and Other Miscellaneous Castings Are Made in the Jobbing Department Located in the Same Building as the Pipe Shop

is all of the time actually required to dry the molds thoroughly.

The process of molding, blacking and drying is continuous, the interval of time between the arrival of flasks at the dryer in every case being six minutes. However, from the drying pits through the remainder of the operations, the flasks travel in groups of five, and the working of the schedule becomes more apparent. Once every 30 minutes, five flasks containing dry molds are taken from the drying pits by the crane and placed in position at the pouring department, as shown in Fig. 1. As the mold is set in position, a safety chain, shown on the flasks at the right, is attached to the flask as an added factor of safety and to prevent tipping. It is interesting to note that the flasks have been designed with a low center of gravity, which to a great degree prevents tipping.

Fig. 6—Molds Are Rammed with Pneumatic Rammers. One Mold Is Finished While Another Is Being Rammed

One additional clamp is placed on the bell end of the flask and the mold is inspected again with the aid of a flashlight held at the top. An aluminum guide is placed in position at the top of the mold to prevent damage to the mold when the core is lowered. A description of the core making procedure will be deferred until later. Cores coming from the second battery of drying ovens are held on cars in the bay adjacent to the pouring pit, as may be noted in the background of Fig. 1. An interesting method, employing two cranes, is used to handle the cores from the oven cars to the mold. The crane in the center bay, in which the pit is located, is attached to one end of three core arbors with the aid of the clevis and pin shown in Fig. 1. At the same time a crane in the bay in which the core cars are located and which is parallel to the center bay, is attached to the opposite end of the core arbors. Both cranes lift at the same time until the cores are clear of the car, and then while the crane in the center bay continues to lift, the crane in the side bay slacks off and allows the cores to come to a vertical position under the crane in the center bay. The three cores for the flask are lowered into the mold at one time. The workman then sets the three head cores in position and nails them in with four, wrought-iron nails. These nails are covered with a quick setting mixture consisting of sand and glutrin water. The body core then is centered and held in place with four nails.

Instead of pouring the three molds at one time from a single runner basin, the molds are poured one at a time. This method of pouring was adopted at the Clow plant to decrease losses due to trouble encountered while pouring. When all three molds are poured at one time, any trouble encountered with one mold usually produces scrap of all three pipe in the flask. On the other hand, when pouring one at a time, one pipe may come bad without affecting the remaining two.

Construction of the flask is the key to success when pouring one mold at a time. With a flask having only sand separating the molds, it may be seen that smoke and gas from the mold being poured would pass through the sand to the adjacent mold, and when that mold was poured, this gas would result in a bad casting. As may be noted in Figs. 1 and 2, the flask is constructed in such a way that a metal wall separates the molds. This feature prevents gas passing from the mold being poured to one which has not been poured. Care also is taken to prevent metal spilling into the mold not poured. Guards, which may be noted in Fig. 1 are placed between the molds.

The molds in the flask, shown at the left in Fig. 1, are poured first. As soon as the last mold, shown at the right in Fig. 1, is poured, the crew starts pulling the core bars on the first molds poured. The three cores are hooked to a flexible shackle attached to the crane hook, and are pulled at the same time. A hook from the crane in the side bay is attached to the bottom end of the core bars and the bars are swung into position on a car in the side bay in much the same manner as the cores were handled before they were placed in the molds.

Cool for 30 Minutes

Immediately after the core bars are pulled, the flasks, containing the sand and pipe, are picked up by the crane and carried to the shakeout platform, where the pipes are allowed to cool for 30 minutes. A better idea of the heavy lifts that must be made continually in a pipe shop, may be had from the knowledge that a flask containing three 6-inch pipe and the necessary sand weighs 6 tons and that three 8-inch pipe, the flask and sand weigh 8 tons.

After cooling 30 minutes, the flasks are picked up by the crane and carried to the shakeout skids, shown in Fig. 2. Immediately before the flasks are moved from the shakeout platform, all but two of the clamps are removed from the flask. As may be noted in the illustration, two hooks from the crane are engaged in loops cast in the sides of the flask. When the two remaining clamps have been removed, the flask is lifted, causing it to swing open, permitting the sand and pipe to drop from the flask. The three pipe fall on the skids and roll to the cleaning department located in a shed at the side of the main foundry building, where the core sand is cut out, the runner heads are removed, the thin metal fin, caused by the opening between the head core and the main core, is chipped off, and any necessary grinding is completed. While this work is being done, the pipe are inspected thoroughly. The pipe then are dipped in tar, tested under 300

pounds hydraulic pressure, weighed and sent to the shipping platform.

The sand falls through the grating under the shakeout skids, shown in Fig. 2, into a hopper below. It then is carried on an apron conveyor, to a belt conveyor. The belt conveyor carries the sand over a magnetic pulley separator to an elevator boot. The elevator carries the sand from the boot and deposits it in a storage hopper, shown at the upper left in Fig. 4. An apron conveyor carries the sand from the storage hopper to the mixer and a belt conveyor transports the sand from the mixer to a storage bin near the molding station.

Sand used in the pipe shop consists of a synthetic mixture of silica sand and clay binder. The clay wash, used to bond the sand, is mixed in a tank on the floor level and is elevated pneumatically to a tank located above and to one side of the mixer. A muller type mixer, made by the National Engineering Co., Chicago, is used and the entire system is controlled by the operator from the platform at the side of the mixer.

Use Automatic Device

Eighteen cubic feet of sand constitutes a batch and this amount is measured into the mixer by an overload relay. This relay stops the apron conveyor which carries the sand from the storage hopper to the mixer and also the apron conveyor which carries the sand from the hopper below the shakeout grating to the cross belt conveyor. The belt conveyor and the elevator operate continuously. When the operator starts the conveyor, he also opens the valve to the claywash tank, and when the conveyor is stopped by the overload relay, the operator shuts the valve. However, under the continuous system of operating the sand arrives at the mixer with almost a constant temperature and moisture content, so that a constant addition of claywash gives practically a constant moisture content in the prepared sand He tests the sand for moisture and bond strength after it has been mixed thoroughly in the muller, using the well known method of squeezing a lump of sand in the hand, and if necessary, more of the claywash mixture is added. After sand has been mixed, it is dumped manually on the belt conveyor.

A remarkable saving has been effected through the installation of the sand preparing system. With old methods of mixing sand, the loss at the plant was in the neighborhood of 6 per cent. However, since this sand preparing unit was installed and sufficient amount of experimental work completed to determine the proper procedure to follow, the loss has been cut to below 2 per cent. Daily tests are made to American Foundrymen's association specifications in a well equipped sand testing laboratory located at one end of the shop, and these tests show exceptionally small variations in the moisture content and the bond strength. Between 5 and 6 per cent moisture is used.

The sand preparing system also has assisted in reducing the time for drying. This is accomplished by removing the fine particles from the sand before the bond is added. Dust and fine sand are removed by suction at four points in the system, namely at the point where the apron conveyor dumps sand on the cross belt conveyor, at the elevator boot, at the top of the elevator and at the top of the mixer. Since the synthetic sand mixture has been used the amount of moisture provided in the sand also has been reduced, cutting the drying time.

One of the important factors governing the production of cast-iron pipe is proper cores. As in the case of the other departments, the installation of adequate equipment and a careful study of production details have made it possible for the core department to supply excellent cores. The equipment consists of four core making machines and four batteries of ovens of three ovens each. Two batteries of ovens are used for drying the 6-inch cores, one group of four drying the first coat and the other group drying the second coat. The same procedure is followed in making cores for 8-inch pipe. Loam for the first coat is mixed in a mill near the machine which applies that coat and loam for the second coat is mixed in a mill in the rear of the second coat machine, as may be seen in Fig. 3.

The core machine consists of a simple type, power-driven lathe which turns two core bars at the same time. Loam used to coat the molds is carried on a special table between the two bars. In making the cores, the bar first is wrapped with corrugated paper. A coating of loam then is applied to the bar by hand, the loam being smoothed to the approximate shape desired by a straight edge on the frame of the lathe. Both cores then are picked up by a special crane electrically operated, which is controlled by one of the coremakers from a position near the lathe, and are carried to a core oven car in front of one of the four ovens. When the car has been loaded, it is placed in the oven.

Fig. 7—A Special Apprentice Department Is Maintained Where 15 Young Men Are Instructed in Foundry Practice

After the cores have been dried, the car is pushed out through door on the other end of the oven to the department where the second coat is placed on the core. Practically the same type of machine is used in applying the second, except that only one core is finished at a time. After the second coat has been placed over the first coat which already has been dried, the knife edge is cleaned and blacking is applied, as is shown in Fig. 3. The blacking is smoothed over the core surface with the aid of the knife edge. The core then is picked up by a crane, in the same manner as before, and placed on the car. When this car is loaded, it is pushed into one of the second battery of four ovens, which are built parallel to the unit used for drying the first coat. After drying, the car is pushed through the oven to the side bay along the drying and pouring pits. Heat for the ovens is supplied by furnaces built by the Mayor Fuel Saving Furnace Co., Cleveland.

In contrast to the practice in some shops, socket cores are made from

Michigan City sand, bonded with an oil binder. These cores are made on benches located near the core machine shown in Fig. 3, and are dried in one of the ovens in the unit used to dry the second coat on the 6-inch pipe cores. A sufficient number of cores are made in two shifts to supply the needs of the shop. However, it is necessary to operate the pipe core department three shifts.

Metal for the pipe shop is melted in one of a battery of three cupolas which, as previously mentioned, is located between the pipe shop and the fittings foundry. A smaller cupola, located at one end of the battery, melts the iron for the fittings shop. One of the interesting features in connection with melting practices in the pipe shop is that the cupola is operated 24 hours before the bottom is dropped. In this way one cupola is operated one day, cools the second day, is repaired the third day and is operated again the fourth day. The bottom usually is dropped between 9 and 10 in the morning.

Crane Charges Cupola

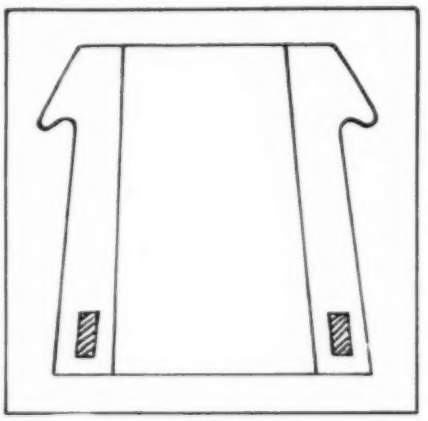
The storage yard is located at one side of the foundry building immediately in the rear of the cupolas. The yard has bins for storing pig iron, scrap, coke and limestone and in addition has two sidetracks. Materials to be charged are carried from the yard to the cupola by a crane equipped with an electric magnet, and in many cases the pig iron and scrap are carried directly from the railroad car to the charging platform.

Charges are made up on a charging pan immediately in front of the charging door. The coke and limestone are carried to the charging floor in the crane bucket and the required amount is shoveled upon the pan by a man on the charging platform. When the charge is complete, one end of the pan is raised, dumping the charge in the cupola.

The company purchases only No. 2 foundry iron and uses only railroad scrap and returned scrap. Close control of the silicon and sulphur content of the iron is obtained. The silicon content runs about 1.75 per cent with a spread of from 1.60 to 1.90 per cent, while the sulphur runs in the neighborhood of 0.075 per cent with a spread of from 0.07 to 0.095 per cent. Iron is tapped at a temperature ranging from 2550 to 2600 degrees Fahr. and is poured at about 2359 degrees Fahr.

The fittings shop of the Clow company now is in the process of rearrangement, with the ultimate aim of molding practically all of the work on machines. At present, practically all work up to 16-inch is molded on machines, four rollover-jolt machines built by the Herman Pneumatic Machine Co., Zelienople, Pa., and one rollover-jolt machine manufactured by the Osborn Mfg. Co., Cleveland, being used for this work. Fittings above 16-inch and miscellaneous work are made on the floor. A view of one bay of the fittings shop showing two of the rollover-jolt machines is shown in Fig. 5. The cupolas are located in the brick enclosure at the end of that bay.

A central shakeout station is used in the fittings shop and all molds, except those made in the apprentice department, are brought to the shakeout by the night crew. The sand



THE STEEL BAND WAS CAST IN THE MOLD TO PREVENT CRACKING

falls through the shakeout grating to a belt conveyor. The belt conveyor carries the sand over a magnetic pulley to an elevator boot where a bucket elevator carries it to the paddle type mixer built by the Standard Sand & Machine Co., Cleveland. After the sand has been mixed it is dumped into a storage hopper and later is carried to the various molding floors either in 5-ton boxes or in electric dump trucks. The fittings shop produces approximately 30 tons of castings daily.

A special apprentice course is offered to a limited number of boys by the Clow company. When accepted, the boy is set to work under a competent instructor and is paid a nominal wage. If the boy makes progress and shows promise of mastering the work, he is given an increase in pay each 3-month period. He is started on simple work in a special bay reserved for the apprentice division as shown in Fig. 7, and gradually is advanced to more difficult work. When the instructor believes that the boy has secured a sufficient amount of knowledge to permit him to do the regular work in the shop, he is sent to the fittings shop and is given an increase in wages. Fifteen boys are being trained in this school.

Another type of apprentice work is undertaken by the company. Six young men are taken from the group of helpers in the plant and are placed at work making large work under a competent instructor. D. I. Miller is works manager of the Coshocton plant and Guy P. Clow is works superintendent.

Casting Steel Inserts in Heavy Castings

By James Thomas

Some foundrymen believe that benefit may be derived from placing steel bars or rails in iron castings which are subject to heat strains, such as sprue plates, stools and ingot molds, however, this is not the case. The steel bar or rail cast in the heavy section of the metal becomes crystalized when cooling with the casting. If the casting is broken at the point where the steel is placed, an examination of the steel will show that it is brittle in a greater degree than the cast iron.

Lines of weakness are found where the inserts are placed, in addition to the weakness caused by crystalization. This is due to the metal not fusing with the steel insert and to the difference with the expansion and contraction of the metals. This factor would be involved every time the casting is used.

Some years ago the writer made ingot molds with a steel band cast near the bottom as shown in the accompanying illustration. The steel band 1¼ x 4 inches was cast in the ingot molds to prevent cracking and to prolong the life of the mold. This band did not accomplish the purpose for which it was intended, and the mold did not give as much service as one cast without reinforcing. The author also has cast stools with reinforcing which developed the same trouble. On certain lighter castings for machinery parts, inserts may be beneficial.

Made Chicago Manager

Carl F. Weiblen, formerly manager for the G. H. Williams Co. at Cleveland and previous to that a member of the home office organization at Erie, has been appointed Chicago manager for that company. Mr. Weiblen replaces R. B. Randall, who is taking over the position of Pacific Coast manager for Link-Belt Co., Chicago, with headquarters in San Francisco.

Advancements

IN CAST IRON QUALITY Show Definite Progress

By Edward E. Marbaker

Part I

IN RECENT years it has been more or less obvious that gray cast iron has been regarded with some doubt by engineers as a material of construction. Confidence apparently has been lost in its uniformity of quality, and when it is used excess weights are specified to provide a large factor of safety. This tendency has been emphasized by the advent of structural steel, and the improvements attained by welding, forging, and stamping. Since gray cast iron is a relatively cheap material, the foundry man has little leeway in the direction of cost reduction, so he must look for some way in which to improve the quality of the material.

It is only in recent years that the interest of the metallurgist has been directed toward the study of the problems presented by gray iron. That has been because the foundry man has realized the importance of the improvements in steel which have been brought about by careful metallurgical study, and also for the reason that something has had to be done to strengthen the position of gray cast iron as a material for machine construction.

It is believed that a useful purpose would be served if all the material which has been written in the technical and trade journals was gathered together in a more or less connected form, and thus acquaint the foundry man and the engineer with the progress which has been made in the improvement of the properties of gray cast iron, and perhaps bring to the attention of the foundryman methods with which he has not been familiar, and which he might like to try in his own foundry. A great deal has been written in foreign journals about pearlitic cast iron, but it seems that little is really known about it especially in this country. Regular production of this material was one of the steps in the quest for the improvement of gray cast iron. It is the object of this paper to discuss, nontechnically as far as possible, the metallurgy which has been involved in the investigations, and to follow the development of the various processes historically.

Gives Information

COMPARATIVELY little literature has been published in this country on processes developed in Germany for the production of cast iron with a pearlitic structure, and in this article which will be published in two parts, the author will bring out the essential points relating to the methods employed. Dr. Marbaker, author of this article is holder of the Whiting Corp. industrial fellowship, Mellon Institute of Industrial Research, Pittsburgh.

As early as 1890, metallurgists generally recognized the fact that steel containing about 0.9 per cent carbon, when annealed, had desirable properties as to strength and toughness. Under the microscope this steel showed a peculiar lamellar structure consisting of alternate layers of pure iron, ferrite, and the carbide of iron, cementite. The white parts of this structure possess a pearly luster and to distinguish the material, Sorby called it pearlite. This same structure was noticed in cast iron, but, of course, always accompanied by greater or less amounts of graphitic carbon which had separated out during cooling. It also was noted that when the fracture showed considerable amounts of pearlite, the strength and toughness of the cast iron were improved greatly. It is probable that all gray cast iron has contained more or less pearlitic structure, but it was not until recent years that definite attempts were made to produce cast iron which would possess this structure throughout all sections of a casting.

To understand the nature of pearlitic cast iron, the phenomena which take place when iron-carbon alloys solidify from a high tempera-

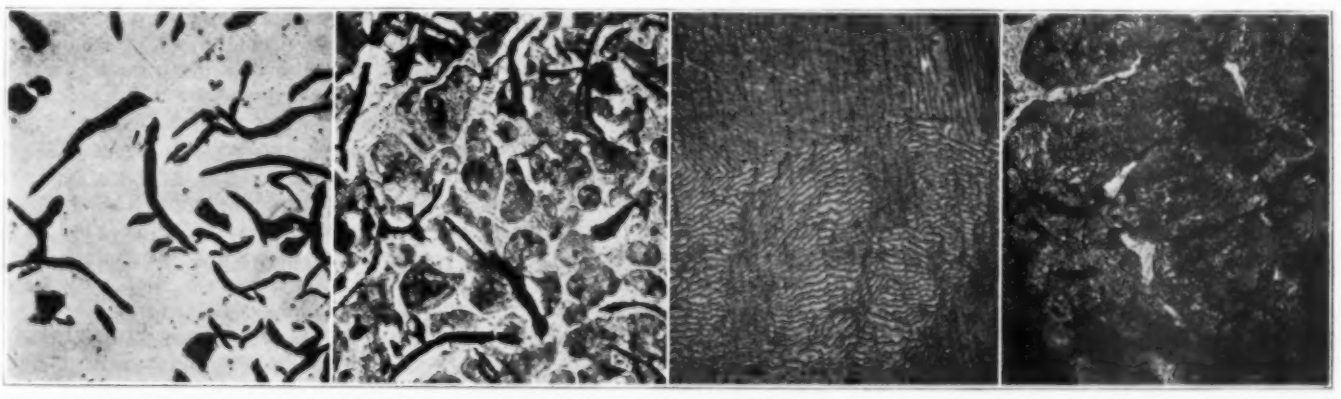


FIG. 1—ORDINARY CAST IRON, UNETCHED, 75 DIAMETERS. FIG. 2—ORDINARY CAST IRON, ETCHED WITH 5 PER CENT NITRIC ACID, 75 DIAMETERS. FIG. 3—ALL PEARLITIC STRUCTURE, ETCHED WITH PICRIC ACID, 175 DIAMETERS. FIG. 4—CAST IRON WITH PEARLITIC STRUCTURE, ETCHED WITH PICRIC ACID, 500 DIAMETERS

ture must be examined closely. Cast iron, that is, iron associated with more than 2 per cent carbon, cannot be said to have a definite freezing point, but rather a range through which the constituents solidify and separate. The length of the solidification range is governed by the composition of the iron, the latent heat, and the rate of cooling. The lower the percentage of impurities present, the shorter the range and the higher the temperature at which freezing begins.

Freezing point of pure iron is 1500 degrees Cent. (2732 degrees Fahr.), and as is the case with water solutions which have lower freezing points than pure water, the solution of carbon in molten iron has a lower freezing point than that of pure iron. The difference in freezing point depends upon the amount of carbon or other impurity present. Cast iron always contains beside the carbon varying amounts of silicon, manganese, phosphorus, and sulphur. The presence of these elements affects the freezing point of the molten iron also, but for purposes of discussion only the iron-carbon alloy need be considered.

Gives Freezing Points

Ordinary cast iron begins to freeze at 1240 degrees Cent. (2264 degrees Fahr.) and immediately afterward the relatively unstable carbide of iron, cementite, begins to split up and primary graphite and ferrite are formed. At 1130 degrees Cent. (2066 degrees Fahr.) the eutectic of 50 per cent austentite (solid solution of carbon in iron) and 50 per cent cementite, containing 4.3 per cent carbon is formed. The eutectic is called ledeburite. The cementite is a hard and brittle constituent, and is seen in castings which have been chilled. White cast iron consists principally of cementite. The amount of graphite thrown out of solution depends upon the amounts of carbon, silicon, manganese, phosphorus, and sulphur present in the alloy, and the rate of cooling.

Cooling continues down to about 940 degrees Cent. (1724 degrees Fahr.), where the phosphide eutectic solidifies. This point is the end of the solidification range. Secondary graphite continues to be formed down to 750-700 degrees Cent. (1382-1292 degrees Fahr.), but cannot grow large because the mass is completely solid. The remainder of the carbon which has not been thrown out as graphite, and still is combined with the iron, is present as the eutectoid, pearlite, which is a mixture of seven parts ferrite and one part cementite, and contains 0.90 per cent carbon. If the separation of graphite continues, the final mass will consist of ferrite and graphite.

Ordinary cast iron solidified rapidly or quenched from the high temperatures will consist largely of cementite and be hard and brittle, while if the cooling is allowed to proceed slowly the final product will be soft iron and graphite, a material which is soft and which has little strength. Obviously the structure desired must lie between these two extremes, and it has been found that pearlite associated with finely divided and well distributed graphite possesses great strength and toughness.

Develop Production Method

It is stated that in 1910, P. A. Diefenthaler and Karl Sipp, metallurgists in the foundry of Heinrich Lanz, Mannheim, Germany, started to work out a process for the production of pearlitic cast iron which could be depended upon to confer upon the casting greatly increased strength and toughness. The first German patent, No. 301,913, was granted May 10, 1916. What appealed to the inventors first, however, was the wearing qualities of this type of gray iron, and they saw a great future for it in the manufacture of internal combustion engines. Its value in this direction was enhanced also by its constancy of volume under conditions of repeated heating and cooling. In other words, this cast iron did not *grow*.

The process finally evolved by these workers and which subsequently became known as the Lanz process consists of a charge of comparatively low carbon and silicon contents melted in an ordinary cupola and poured into molds preheated to temperatures depending upon the thickness of the casting section and the carbon and silicon contents of the charge. Carbon and silicon are kept low so that in cooling as little as possible of free graphite is formed, because this constituent tends to weaken the structure of the cast iron.

Apparently the new process developed slowly for the first British patent was not granted until 1920. Public interest in the process was first aroused in 1922, when O. Bauer published in *Stahl und Eisen* and other journals a paper entitled "The Formation, Mechanical Properties, and Practical Applications of Pearlitic Cast Iron," although Sipp, *Stahl und Eisen*, had published a short article in 1920. A translation of the paper appeared in the *Foundry Trade Journal*, 1923, and as a result, a controversy sprang up in England as to whether the patent should have been granted in view of the fact that a considerable volume of prior art on the subject existed. There were also those who believed the inventors were claiming too much for their product, and that the explanation for the improvement in the properties of the cast iron given in the patent was not correct. It seemed that a good many people had some knowledge of the subject before the patent had been issued and discussed, although no statements had been made. Discussion of the subject was presented by Young, Mills and Adamson in the *Foundry Trade Journal*, 1923.

However, the Lanz Co. was not deterred by this antagonism, and established July 20, 1925, the British Perlit Iron Company Ltd., for the purpose of exploiting the process and granting licenses to prospective users of the process in Great Britain and the Colonies, *Foundry Trade Journal*, 1925. The Lanz process and its improvements had been patented by this time in practically all foreign countries and in the United States. There were about 12 licensees operating in England alone, according to Werner, *Foundry Trade Journal*, 1925. In 1926, there was no licensee in this country, and the literature shows no reference to any since that time. As the use of the process expanded in England, its details were discussed at length in the technical periodicals, and the properties of the cast iron which was produced were given a great deal of attention. Some of the metallurgists who were antagonistic at first were convinced finally by their own experience that the cast iron so produced actually possessed the properties claimed for it, and that the material could be produced regularly and uniformly.

Use Another Method

However, it was not allowed to go on without competition. The inventors of the Lanz process claimed priority in the manufacture of cast iron having a pearlitic structure, but other investigators believed that the only valid claim in the patent was that covering the process by which the pearlitic structure was produced, and went ahead with their own work. The most important process offered in competition with the Lanz process was that worked out by Karl Emmel, *Stahl und Eisen*, 1924, in the plant of Thyssen & Co., Mulheim, Germany. This process was altogether different from the Lanz process, as will be shown later. The British patent, No. 244,405, was granted Nov. 11, 1926. Apparently it has not been used to as great an extent as the Lanz process, although several investigators,

Richman, *Foundry Trade Journal*, 1925, and Francis, *Metal Industry* (London), 1926, have stated that it is the better method of the two for manufacturing cast iron having a purely pearlitic structure. It also has been claimed that the graphite formed in this type of cast iron is more finely divided and more evenly distributed than in the case of Lanz iron, and this is one of the reasons for its extremely high strength. Probably the most important feature of this process is that it calls for no special equipment for melting or pouring.

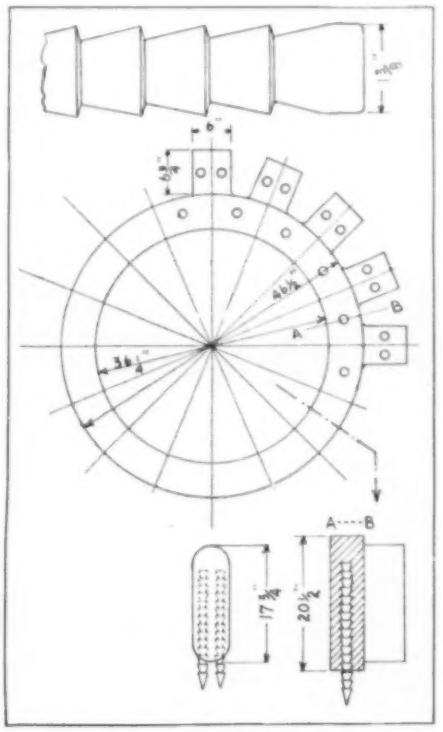
Later developments have been brought about by Kerpely, *Giesserei Zeitung*, 1928, using the electric furnace and superheating the iron before casting. It has long been held that superheating improves the quality of cast iron, but the means have not been available for carrying this out. Wust, according to Klingenstein, *Stahl und Eisen*, 1925, invented an oil-fired cupola which has produced pearlitic cast iron of satisfactory properties, and mention has been made of the iron producible by melting in the powdered coal-fired cupola. Corsalli has also obtained high duty cast iron by means of superheating in the cupola. Schuz, *Stahl und Eisen*, 1925, found that graphite eutectic (ferrite-graphite) is formed when iron containing 3 per cent silicon is superheated and rapidly cooled, and this material shows a finer grain and greater strength than the pearlitic structure.

Lanz and Thyssen were engaged in litigation, Lanz holding that Thyssen had infringed the original pearlite claims, but according to Smeeton, *Foundry Trade Journal*, 1928, this litigation was terminated by a settlement in which the opposing firm agreed to recognize the novelty, validity and economic value of the Lanz process.

Literature Is Lacking

Literature contains no references to primary investigations carried out in this country on the production of cast iron of pearlitic structure. However, the subject of producing high duty cast iron is receiving considerable attention from the standpoint of alloy additions. Nickel and nickel-chromium additions to molten ordinary cast iron according to the International Nickel Co., New York, have been shown to produce remarkable results in increasing the strength of the castings and the resistance to corrosion. There are also practical advantages claimed to be derived from the uniformity of metal containing such additions. An objection to the process now is the high cost of the nickel, and it is for this reason that little interest has been shown in the subject in England.

In general, foundrymen and metallurgists have become aware of the possibility of improving the properties of gray cast iron by the application of the methods which have been so successful in the study of steel problems. Several methods, based on the same fundamental principles, have been worked out in detail, and some of them have been reduced to commercial practice and their value has been clearly demonstrated. The formation of pearlitic structure throughout all sections of castings is said



METHOD OF APPLICATION

to be desirable and is associated with low carbon contents and suitable cooling methods, either by the use of superheated melts or properly preheated molds. The effect of the silicon content is also of importance.

By virtue of the experimental and practical work referred to in the preceding paragraphs, the position of gray cast iron has been improved greatly. It is to be expected that, as more study is devoted to the complex problems involved in the manufacture of gray iron castings, the results will be all that foundrymen and engineers can wish for.

Interstate Supply Co., Commercial Trust building, Philadelphia, has been appointed the representative in the Philadelphia district of the Northern Engineering Works, Detroit. W. H. Beyer will be in charge.

Applies Cooling Rods in Steel Castings

Question: To attain uniform cooling speed and also to reduce the size and number of feeding heads we introduced a number of cooling bars or rods in the 6000-pound steel casting shown in the accompanying illustration. The ring has an outside diameter of 46½ inches, inside diameter of 36¼ inches and is 20½ inches deep. It is surrounded by 16 projections 6 x 6¾ inches, almost the full depth of the ring and spaced equidistantly on the perimiter. The casting was perfect in every particular with the exception that the presence of the cooling rods could be detected after the face of the wheel was machined. The customer claimed that the rods weakened the casting and refused to accept it. We shall appreciate your opinion on the following points: Are the cooling irons too close to each other; does the American custom favor the use of coolers to this extent; do you think these coolers, made from cast steel have weakened the wheel in any respect?

Answer: Without a knowledge of the purpose for which the wheel is intended it is impossible to give a direct yes or no answer to any or all of your questions. If the wheel is designed to travel slowly or to carry a light load, the numerous cooling rods will not affect it adversely. However, if the contrary is the case and the wheel travels at high speed or carries a heavy load, the rods are a menacing factor. The rods do not unite solidly with the surrounding metal and therefore the resulting casting is in the same condition as if a number of holes the same size as the rods had been drilled into it. Cooling rods are employed freely in American steel foundries, but discretion is observed in regard to the castings in which they form a part. The spirit of economy prompts every foundryman to cut down on the size and number of the feeding heads on steel castings but under certain circumstances, no other method is satisfactory.

The Chicago Pneumatic Tool Co., New York, has published a 70-page catalog describing the various types of equipment which it manufactures. Items of interest to the foundry industry include chipping hammers, various types of rammers, portable grinders, couplings, air hose, air hoists, etc. The publication is well illustrated with reproductions of photographs and contains tables giving the specifications of each type of equipment.

CORE MAKING

Is Mixture of Sand, Binder and Brains

Clean Sharp Sand with Uniform Rounded Grains Most Satisfactory—Action and Characteristics of Various Binders Described—Baking Temperatures and Typical Mixtures Given

By O. W. Potter

MANUFACTURE of castings usually involves the use of dry and green sand cores. A core is defined by Dr. Moldenke as "A body of green or dry sand placed in a mold to form a corresponding cavity in the casting." The present description is confined to the dry sand core.

Important features in producing cores commercially include: Sands, binders, washes; sand mixing equipment, molding machines, ovens; core boxes and forms.

Grades and kinds of sands used for cores include river sands, lake sands, sea sands, glacial sands, sandstone deposits, etc. An ideal sand is composed of rounded grains of uniform size and a mesh size, which will require the minimum amount of bond, give the maximum porosity to the core, and at the same time impart the necessary smoothness to the particular job in hand. However, in many instances the sands used are those found in the vicinity of the foundry.

Attention has been given to the qualities and requisites of a good core sand only in recent years. Considerable study has been devoted to foundry sands in general, and while much has been learned, their importance is just commencing to be realized. Some foundries are making periodical and systematic tests of their sands. Some sands are being bought on analysis and average fineness tests. Attempts are being made to define a rational specification for foundry sands.

Lake sands, known as blown sands, generally are considered most desirable of the natural deposits. Usually they are uniform and clean. Action of the lake waters and the wind have sorted and removed the alkalies, lime, clays, and fines. Grains have been rounded by the water and wind, and thus these deposits are composed of rounded grains of nearly pure silica, quite uniform in size. Sea sands usually contain salt, an undesirable factor in a core sand. River sands contain considerable quantities of fines, high portions of lime and magnesia and varying amounts of clay substance. They are not uniform in grain size. Glacial drift sands are similar to river sands. Sandstone deposits often are cemented together with iron-oxide or lime, a semi-rock material difficult to break and therefore not desirable as a core sand.

Some of the more important qualities to look for in a good core sand are: 1. Rounded grains of uniform size that are tough and will not crush readily in mixing and cleaning. 2. Absence of organic matter, clay and other natural bonds. 3. Absence of alkalies, lime and magnesia. 4. High refractoriness.

THIS article is abstracted from a paper presented by O. W. Potter before a recent meeting of the Twin-Cities Foundrymen's association, Minneapolis. Since its inception Mr. Potter has taken an active part in the affairs of this association and also has contributed several valuable papers to the "Transactions" of the American Foundrymen's association. He is a practical foundryman and in addition has served for several years as instructor in the University of Minnesota. At present he is connected with the Port Crescent Sand Co., Detroit.

Practice and experiment have proved definitely that sands composed of rounded grains of uniform size require the least bond, may be rammed uniformly more easily and have a definite permeability value. Grains that pass through a mesh of 60 to 70 are most desirable for the average run of work. Sands composed of various sizes grains do not vent as easily. They require more bond and generally are more difficult to handle satisfactorily and economically.

Cores which must present a smooth surface may require sand less than 60 to 70 mesh. Ordinary molding sand sometimes is added to core sand to produce a smooth surface. A smooth surface also can be obtained by applying a core wash.

Organic matter, clay and other natural bonds are not considered desirable in a good core sand. They counteract the bonds added and also reduce the permeability. They are especially undesirable when used with oil. Only a pure clean sand should be used and whatever bond is needed may be added in measured quantities.

Refractoriness of the sand is reduced greatly by the presence of alkalies, lime and magnesia. Alkalies also draw moisture, and often react on the bond to reduce its effectiveness. The higher the silica content the more refractory the sand.

Angular sand packs irregularly, is difficult to bond and ram properly, and is unsatisfactory from a permeability standpoint.

Core binders include a wide variety of materials; but may be classed generally as follows: 1. Oils (linseed oil and compound core oils). 2. Paste binders (wheat, rye and corn flour, dextrine and starches). 3. Colloids: *a*, Clay, alumina, magnesia, iron-oxide and manure. *b*, water soluble mixtures, molasses, hydrol, glucose, and sulphite liquors from paper pulp. 4. Pitches and gums, rosin and tars.

Linseed oil is considered by many

the ideal core binder. It is the binder usually used as a standard of measure when comparing the relative strengths of core binders. It is the basis of most of the core oils in which it is combined with various vegetable oils, mineral oils and rosin. A good grade of commercially compounded core oil is so balanced with the other ingredients that equal bonding results are obtained, as from pure linseed oil and at a lesser cost. Economies are effected in the lower baking temperature required and in the shorter baking period.

Gives Strong Cores

Oil sand cores will not draw moisture, will increase tensile strength and reduce the necessity of rodding and venting to a minimum. Cores clean from the casting readily and yield exceptionally smooth surfaces.

Oil sand mixtures require thorough mixing and careful baking. They require a little higher temperature and a longer baking period than other binders. The bond depends on the oxidation of the oil and therefore the cores require adequate draft to bake properly.

Flours are among the oldest binders. The bonding constituents of flour are gluten and starch and are found in sufficient quantity only in good grades. Shorts, offals and sweepings are low in bonding constituents and are not satisfactory bonding agents. The gluten constituent is quite unstable, it draws moisture and decomposes quite readily into musty flour of little value for bonding purposes. Excess quantity of flour will cause the cores to swell. Burning flour sand cores give off a cutting, pungent and irritating smoke. Legislation has been attempted against the use of flour on that account.

Starches and dextrins also are binders of the paste type. The latter is the important constituent of a number of commercial dry core binders. Corn flour binders also are in this group. All the binders of this group are reasonably cheap and also have considerable green bond. One of the principal disadvantages of this group of binders is that they draw moisture readily and cores in which they are used are not suitable for green molds unless the molds are to be poured immediately.

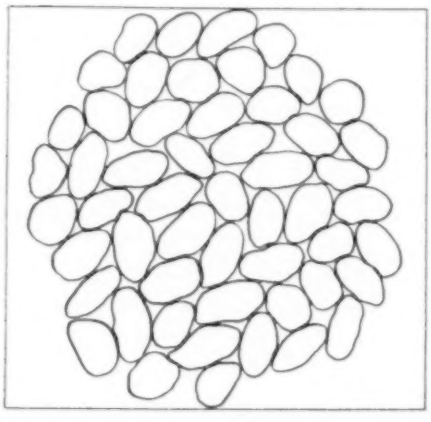


Fig. 1—Uniform, Rounded Grains Pack Easily, Give a Definite Porosity and Require a Minimum Amount of Binder to Cover the Surfaces, etc.

Bonds of the colloidal group include clay, milk of lime, magnesia, aluminum and iron compounds. The bonding quality is due to the colloidal (glue or jelly like) condition of the ingredients. Moisture is necessary to form this colloid. Because of this fact these bonds are often used with the flours, dextrins, etc., objectionable principally because of their ability to draw moisture. The colloids are seldom used alone for core purposes but work well with the paste binders and those of the water soluble group. They take up the moisture absorbed by the other bonds and form the colloidal substance which materially aids the bonding. They also prevent the migration of moisture to the surface during the baking period, a characteristic of water soluble binders. The bond in all our natural molding sands is colloidal. In the pipe industry horse manure is used for certain loam cores.

Table I

Drying Temperatures

Binder	Degrees Fahr.	Speed
Core oils	400-500	Slow
Wheat flour	325	Fast
Dextrin	350-450	Fast
Rosin	325	Fast
Hydrol	350	Fast
Molasses	350	Fast
Sulphate liquor	350	Fast
Pitches	350-400	Fast

The water soluble group includes water solutions of molasses, hydrol, glucose, etc. It also includes the sulphite liquors from pulp mills which are water solutions of the resinous products of the woods used in the process. This group of binders is seldom used alone but almost invariably with some of the dry binders and occasionally with the paste binders.

Gums and pitches form an important group of binders. Rosin is the principal gum bond used. It is mixed in powdered form with sand and baked at a temperature which melts the rosin around the grains. One of the main advantages of rosin bonded cores is that when hot metal is poured around them the rosin burns out and the sand collapses. This property is particularly valuable in high shrinkage castings where a rigid core would cause the metal to crack. Rosin cores are used freely for steel, aluminum and bronze castings. Rosin may be used with clay bonded sands. Sometimes some of the colloidal or paste bonds are added to a rosin mixture to give green bond, a feature in which rosin is lacking. Rosin bonded cores will not draw moisture.

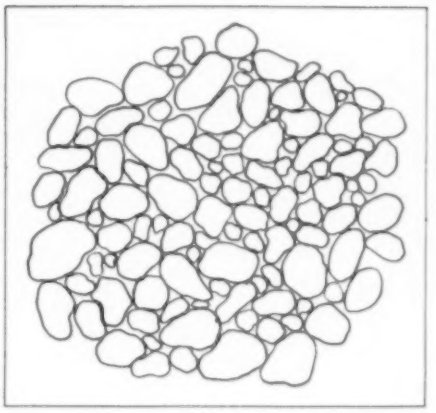


Fig. 2—Varying Grain Size Is Responsible for Low Porosity and Requires Considerable More Bonding Material to Cover the Surfaces

Pitch, a by-product of cokemaking, is a strong and cheap binder. It becomes exceedingly hard when raised to high temperatures, due to a coking process of the carbon present. Cleaning the cores from the castings is difficult. Sea coal mixed with the pitch counteracts this difficulty considerably. For large cores and dry sand molds it is indispensable because it is the only binder which can be dried economically in large masses. It is often used with an oil sand facing. The cores are stable, do not draw moisture and therefore are desirable in molds which must stand a considerable time. Often a large core is faced with oil sand or some other free running mixture and the center of the core is filled with fine coke or sand without bond. This arrangement allows the core to break away from the casting easily. The coke center aids venting and also facilitates the breaking up of the core in the cleaning operation.

Use Other Binders

Other binders have been used with varying success. Salt has been used but the cores draw moisture readily and are difficult to clean out of the castings. Ordinary cement has been tried successfully as a binder, but the caustic action of the cement affected the hands of the coremakers. For machine made cores it might be used successfully.

Core bonds frequently are used in multiple, that is, two or more are used together in the same mix. The total bond in such a mixture is not always

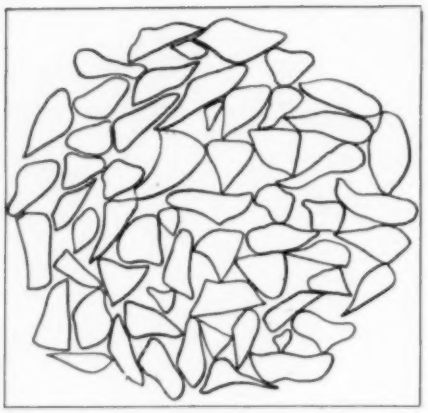


Fig. 3—In Angular Grain Sand the Voids Are Distributed Unevenly Thus Interfering With the Permeability. Wedge Formation Tends to Break the Grains Further Under Pressure

the sum of the individual binders. Oil often is used with starches, dextrins, sugars, gums, flours, and the total bond is practically additive. This does not hold for mixtures of oils with the clays and pitches. Here they seem to counteract each other, or in the case of the clays, the oil seems to be absorbed by the clay, thus reducing the effective bond.

Oil bonded cores are the most desirable for intricate cores, those nearly completely surrounded by metal and those that must be free venting and free running in the cleaning operation. Small cores are made readily from either oil or water soluble binders affording a high bond ratio and giving good solid cores.

Dry binder cores are particularly adapted to large jobs because of their cheapness and the ease of drying.

Wheat flour is disappearing gradually as a core binder because of certain disagreeable properties mentioned. Corn flours and prepared dry binders are taking its place

Corn binders are proving quite satisfactory and economical. Corn flour does not draw moisture as readily as other flours and therefore does not become mouldy or musty, a condition which destroys the bonding power. They are used frequently with the core oils and other binders.

Obtain Smooth Surface

Pitch binder cores are indispensable for large work because of their cheapness, rigidity and resistance to the absorption of moisture. It is easy to get a pitch binder core too hard. Adulterants often are added and the cores usually are faced with a sand that will not scab and is free running.

Core washes are used quite generally to give a smooth surface to the casting and prevent cutting. They usually are made of graphite, soapstone or silica flour mixed with water and glutrin or molasses to make them stick. The wash must be thoroughly dry when the core is used. It may be sprayed on the green cores or painted on dry cores. For bronzes, steels and other metal mixtures that show a tendency to eat into the cores, a thick coating of good refractory wash may be used. It may be put on in successive coats. Each one is dried before applying the next. Silica wash usually is used on steel and bronze. Soapstone or graphite, (plumbago) is used on grey iron and brass.

Relative cost of core sand mixtures may be listed as follows, starting with the cheapest: 1. Paper mill liquors. 2. Pitch binder. 3. Flours. 4. Core oil.

Many items enter into the final cost of cores. The initial cost sometimes bears little relation to the final cost. Mixing, action on core boxes, baking properties, breakage in handling and cleaning qualities are important phases of core costs.

Mixing the core sand and binder is an important operation too often not given proper attention. Sand is mixed by hand shoveling, riddling, paddle type or muller type mixer.

Hand mixing is little practised. Of the other methods the muller type mixer and the paddle type each has stanch supporters. Numerous experiments have been made to determine the time required to develop maximum strength from the bond. Up to 2 hours mulling the bonding strength of sands with colloidal binder still increases. This only goes to show the importance of mixing thoroughly. No sand should be mixed less than 5 minutes and 10 to 15 minutes is much more desirable.

Proper moisture content is another important consideration. A number of interesting and instructive investigations have been made on moisture content in cores and it has been definitely proved that there is a definite moisture content desirable for each kind of binder to give the maximum green and dry bond. C. S. Koch in a paper presented at the Cleveland convention of the American Foundrymen's association and reproduced in THE FOUNDRY, Aug. 15, 1923, gives these figures as:

Pitch binders	6.75 per cent
Corn flour	8.05 per cent
Oil	8.25 per cent

This ideal moisture content is observed by only few foundrymen. They prefer to depend on the feel of the sand. Some of the larger and more progressive shops go to the expense of drying all sands before mixing and of measuring the water as carefully as the binder. This affords maximum results from the binder; assures a more uniform core and less difficulty in drying.

Moisture provides a green bond to the sand, due to the surface tension of the water present; aids the paste and colloidal binders by combining with them to form the bonding substance; aids in the distribution of bond throughout the mix.

Add Binder First

Binder should be added before the sand is tempered with water. If the grains of sand in an oil mix are wet, the oil does not attach itself to the sand grains till the water has been rubbed off. This requires more mixing to get the proper results. After the sand grains become coated with a thin layer of oil, the water just fills the voids between the grains and pushes them apart, thus increasing the volume considerably. About one-third volume increase is estimated for 10 per cent addition of moisture. This means that a given volume of dry core sand will fill more core boxes when it is wet.

Mixtures with clay or other colloids as binder, give better bond values if allowed to stand awhile before using. This is also true of the paste binders, although in warm weather they show a tendency to ferment and dry out and then are not in the best condition for use. Oil sand mixtures are best immediately after mixing.

Drying or baking of cores is important. Different kinds of bond require different drying temperatures and also varying lengths of time. Recommended drying temperatures are given in Table I.

This table shows a spread of re-

Table II

Core Sand Mixtures

Cores for Aluminum
15 parts dry silica sand
5 parts new molding sand
1 part powdered rosin
Bake until rosin melts

Cores for Stove Burners, Pistons, Radiators
60 parts clean sharp sand
1 part core oil

Cores for Bronze Bushings
14 parts sharp sand
4 parts molding sand
1 part flour
Temper with molasses water

Cores for Plumbing Brass
15 parts dry silica sand
5 parts dry molding sand
1 part powdered rosin
Bake until rosin melts (about 350 Fahr.)

Cores for Iron Castings
120 parts open silica sand
1 part core oil
1 part corn flour

Cores for Brass Castings
1 part molding sand
2 parts sharp sand
1 part oil to 60 sand
Temper with molasses water

quired temperature between the various bonds. Oil cores dried by an oxidation process require considerably more time than cores containing the binders. With all binders except oil, no advantage is gained by holding the core at the baking temperature. In many cases this is deterimental.

Effect on the tensile strength of cores, of baking cores at the different temperatures is shown in Table III. Transverse tests were made on linseed oil cores, one inch square and broken on knife edges 6 inches apart. Binder and sand proportion in parts by volume, and four parts by volume of water used in each case.

This means that core ovens should be equipped with pyrometers so the drying temperatures can be checked. Also it is obvious that large cores need a higher temperature and take longer to bake. Cores containing different binders should not be baked together in the same oven. Large and small cores should not be baked at the same time in the same oven.

Core oven construction exerts considerable influence on the making of good cores. Core ovens now are built insulated to prevent heat loss by radiation and they are so constructed that the temperature throughout the oven is uniform. Cores can be baked on the floor as well as on the top shelf. Something that could not be done in many of the old types of ovens. This means a greater capacity for the oven with a minimum of heat losses. The continuously operated oven also has proved economical where large quantities of cores are used. Core ovens are heated by coke, coal, oil, gas, or electricity. Generally speaking oil and gas are the most economical.

Some foundries effect a little economy by burning the coke recovered from the cupola drop in the core ovens. In several malleable plants furnace gases have been drawn through a boiler plant to generate steam for heating purposes including use in core ovens. Utilization of waste heat from the cupola to heat and circulate water is referred to in a recent issue of THE FOUNDRY.

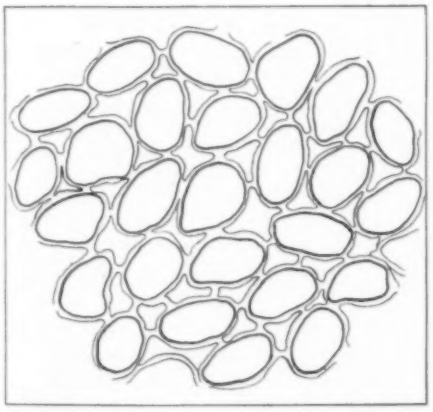


Fig. 4—Water Should Not Be Added Until After the Bonding Material has Been Distributed Through the Sand. The Water Then Fills the Voids While the Core Is Green, but Is Driven Off in the Drying Process Thus Increasing the Permeability of the Core

Table III

Strength Increases with Temperature

Temp. of oven	1 to 50 lbs. oz.	1 to 60 lbs. oz.	1 to 70 lbs. oz.	1 to 80 lbs. oz.	1 to 90 lbs. oz.	1 to 100 lbs. oz.
350	27.....14	25.....5	23.....0	12.....8	10.....6	9.....10
400	44.....10	33.....2	30.....7	29.....7	25.....10	23.....12
450	54.....7	51.....8	48.....4	45.....7	43.....8	38.....14

Wherever large quantities of cores are used and a close check is kept of the results it has been found that the best results are obtained with clean, rather open (60 to 70 mesh) silica sands free from organic matter, clay and other natural bonds. Open sands invariably are recommended in the literature on core sands. Open sands take less bond, vent more freely, bake more rapidly and clean out of the castings much more easily than finer sands. Serious difficulty frequently is encountered with fine sands that only can be overcome by the use of more open sands.

Bond depends largely on the class of castings. It is not considered advisable or economical to have too many core mixtures or bonds in use because as stated before they require different temperatures to bake properly and somewhat different handling. Any reputable bond on the market can be used to advantage with a little careful study. Some binders are more adaptable than others to certain kinds of work. Ideal bond ratio, sand condition, etc., exist for every different bond. It is folly to change bonds frequently but bonds are being improved and every wide awake foundryman should be ready to do a certain amount of experimenting. To test new bonds and make a change when satisfied that a bond is better than those now in use:

1. Use only clean, pure, silica sand, preferably not too fine.
2. Select good standard core binders, study and learn their best use and do not change without serious reason.
3. Mix the sand thoroughly; add water last.
4. Bake at proper temperature.

Some of the common faults to be found in many core rooms include:

1. Use of dirty sand.
2. Use of oil and clay in same mix.
3. Too much binder.
4. Poorly mixed sand.
5. Improperly baked cores.

The ideal core is made from washed, dried and screened sand to desired mesh of average fineness, bond ratio 1:150.

Sand is prepared in a mechanical mixer which automatically measures sand, bond and water.

It is made by core makers who welcome improvements and dried in an oven thermostatically controlled.

This core will be rigid, open, free venting and will fall away from the casting with the mere handling to the cleaning room.

Close Sand Responsible for Shrink Hole

Question: We are sending you three sections cut from a cast iron slug 2¾-inch diameter and 14 inches in length. This casting was made upright in an open sand mold and was poured from a hand ladle. When we cut this into sections we found what looks like a *draw* or shrink hole in the center. What is the cause of this hole in the center of the casting and how can we prevent it from appearing again.

Answer: The defects are caused by iron boiling in the mold, but just exactly what factor causes the iron to boil is an open question. It may be hard sand, damp sand or several of the castings poured too close to each other. Whatever the cause the fact remains that steam was generated in the vicinity of the mold and was forced up through the molten iron because it could not escape freely through the sand. By your letter head we note that you operate a stove foundry, therefore we assume that the slug was rammed in regular stove plate sand. From the absolute uniformity of the casting top and bottom it is apparent that the sand was rammed quite firmly round the lower part of the pattern. Coarse, open sand may be rammed in this manner, but fine sand becomes too solid. It will cause the iron to *kick*. The obvious remedy in your case is to either employ a coarser grade of sand, or stab a ring of ⅛-inch vent holes in the sand close to the pattern before the pattern is drawn out of the sand.

Specializes in

BRONZE BEARINGS

Molding Machines, Cranes, Trucks and Casting Cleaning Equipment Relieve Operators of Nearly All Drudgery and Increase Production — Sand Used Several Times Daily

By Pat Dwyer

EXPERIENCE gained over a period of many years was drawn upon freely by the executive staff of the More-Jones Brass & Metal Co., St. Louis, in the design and construction of a new plant recently erected to take the place of one first built in 1874 and taxed beyond its capacity for many years. The company specializes in the manufacture of bronze bearings for practically every purpose for which bearings are used and has customers all over the world in addition to the railroads and industrial plants of all kinds which constitute its clientele in this country. Engineering salesmen covering the field at home and abroad contributed their quota to the general fund of information on plant layout and construction. Opinions were based on examination of other plants, domestic and foreign, with the defects listed in one catalog and the commendable features set forth in another.

A list of the various departments of the plant, methods and equipment employed in melting from 100 to 150 tons of nonferrous metal daily, also a brief history of the company were presented in a former article which appeared in THE FOUNDRY, July 15, 1928. The admirable manner in which one part of the foundry is equipped to handle the metal is duplicated in the second main division of the building in which the castings are molded and poured.

Describes Methods

THIS is the second of two articles devoted to a description of some of the methods and equipment employed in the nonferrous foundry of a plant recently erected and placed in operation by the More-Jones Brass & Metal Co., St. Louis, now one of a powerful group known as the National Bearing Metals Corp. with plants in St. Louis, Pittsburgh, New York, Portsmouth, Va., and Jersey City, N. J. The More-Jones Co., an old St. Louis institution, first was established in 1874.

The molding floor is divided longitudinally in the center by a 10-foot gangway which extends from end to end of the building. The entire floor, smooth and level, is surfaced with cement, easily kept clean and tidy thus facilitating the movement of the various employes in setting up, pouring and shaking out the castings and afterward in the removal of the castings by tote box and lift truck to the cleaning department. The molds are shaken out where they are poured, the sand is cut over near the molding station and the castings dragged out and placed on the gangway or directly on a truck traveling toward the well equipped cleaning room.

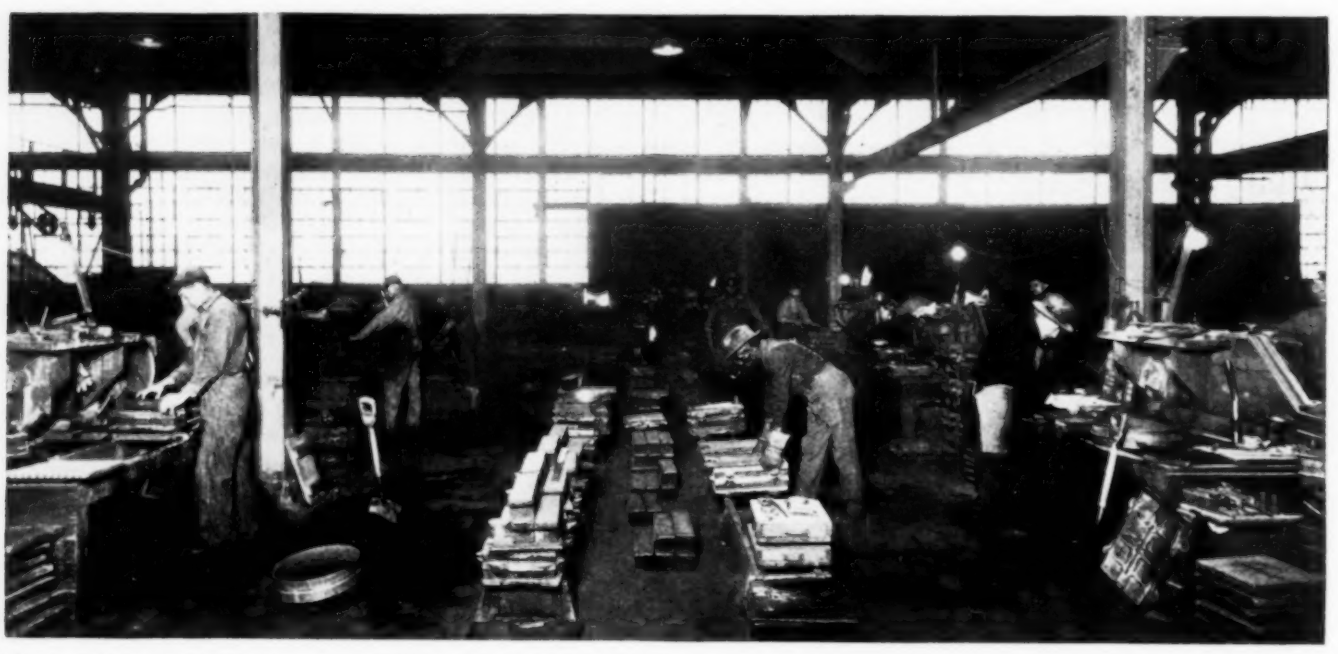


FIG. 1—SMALL, MISCELLANEOUS CASTINGS ARE MADE ON THIS FLOOR, ONE OF SEVERAL ARRANGED IN A SIMILAR MANNER WITH THE BENCHES FOR SIX MEN NEAR THE COLUMNS AND WITH THE MOLDS SET UP FOR POURING IN THE CENTER

Perhaps the best way to present a description of the foundry is to first sketch briefly the general layout showing the relative position of the various units that go to make up a harmonious and smoothly working machine in which an immense quantity of nonferrous metal is handled every day. Afterward some attention will be given to the individual units, interesting features connected with equipment and method of operation.

Floor Layout

The melting department was described in a former issue, therefore no mention of it will be made at this time except that it parallels the molding department throughout its entire length and only is separated from this section by one of the rows of steel columns which support the roof. Columns also serve to mark the boundaries between the various molding floors which are laid off transversely to the main length of the building. A 10-foot gangway divides the floors into a right and a left group. Thus the floors in one group extend from the wall to the central gangway. The floors in the other group extend from the central gangway to the row of columns separating the melting department from the remainder of the foundry. North and south each floor occupies the space between two rows of columns. East and west the floors extend from the central gangway to the wall on one side and to the edge of the melting department on the other side.

All the floors on the wall side are equipped with molding machines supplied by several interests including Arcade Mfg. Co., Freeport, Ill.; International Molding Machine Co., Chicago; Milwaukee Foundry Equipment Co., Milwaukee, and Tabor Mfg. Co., Philadelphia. Some are plain hand squeeze machines. Others are operated by compressed air and are equipped in whole or in part to jolt, squeeze, roll-over, strip and draw the pattern. Many of the floors between the gangway and the melting department are equipped with molding machines but several are arranged for hand molding as shown in Fig. 1 where the molds are made on benches erected in the vicinity of the steel columns. These floors are kept busy on a wide range of small, miscellaneous castings involving an almost continual change of patterns. Benches are arranged in pairs, back to back in the vicinity of the columns. The finished molds are set up for pouring on a double row of low stands in the open, central spaces.

FIG. 3—HIGH POURING HEADS ARE EMPLOYED FREELY ON CASTINGS THAT USUALLY REQUIRE FEEDERS

Only a comparatively small quantity of sand is required. It is used repeatedly throughout the day and since the castings are light and are shaken out immediately after they are poured, the sand never becomes too hot to use. Sand from the Albany district of New York state, in two grades, fine and medium, is used exclusively for making the molds. To a limited extent also it is employed in some of the core mixtures.

Fine sand is used on the majority of the floors. Use of medium sand is confined principally to the heavy jobbing floors at the south end of the foundry where large bushings, mill bearings and other large heavy and miscellaneous castings are made according to the methods prevalent in any up-to-date nonferrous jobbing foundry.

Use Chill Molds

The foundry is designed and operated for a steady flow of materials in one direction, thus avoiding congestion, traffic tieups, expense and loss of time, in some instances the most important factor of all. As a convenience to many customers, also as a balance wheel to equalize production, the More-Jones Brass & Metal Co. makes up and carries in stock a considerable volume of castings.

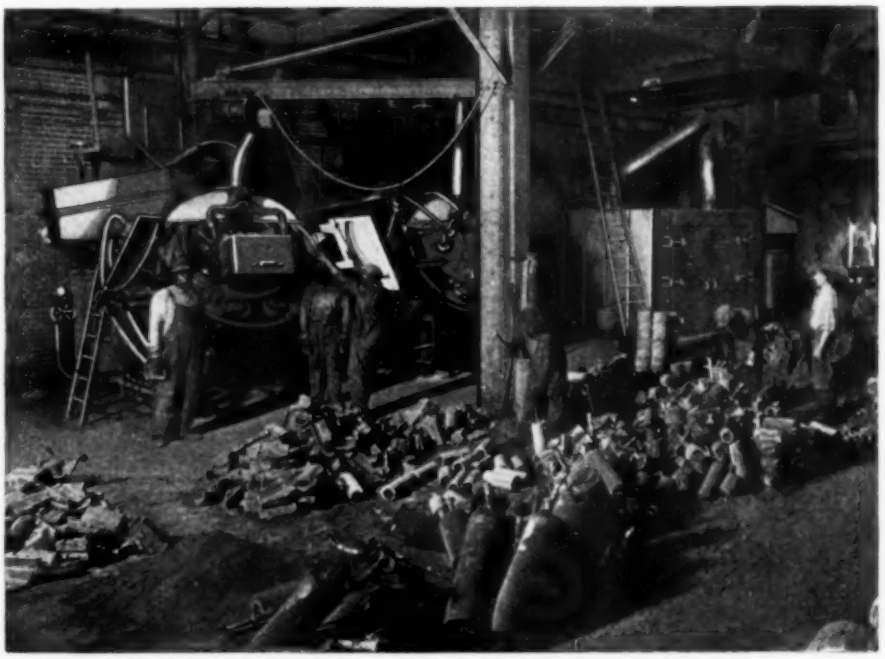


FIG. 2—CASTINGS ARE CLEANED IN A SANDBLAST CHAMBER AND IN TWO REVOLVING SANDBLAST TUMBLING BARRELS

FIG. 4—AFTER THE BRONZE BEARINGS HAVE BEEN CLEANED AND MACHINED THEY ARE LINED WITH SOFT METAL

According to a custom that appears to have invaded all lines of industry within the past few years, the customer allows his stock to reach a low ebb before he orders renewals. Then he wants and expects service with a rush.

Large bearings for locomotives are made in patented molds in one section of the foundry occupying a space the entire width of the building near the south end. Space on one side of the main gangway is utilized for assembling and pouring the molds. A large number of molds showing the wide diversity of sizes and designs still in use on the various railroads, is held in reserve in the space on the opposite side of the gangway.

The molds are mounted in straight rows on low cast iron stands and are transferred from the active to the reserve group and vice-versa by a light crane which spans the entire bay devoted to the production of castings by this process.

The molds are made according to the general design and principles advocated by E. A. Custer in several articles published in THE FOUNDRY in 1908 and 1909 in which he holds that the mold casting must be sufficiently bulky to absorb all the heat radiated from the casting during the period it remains in contact with the mold, and absorb it without causing distortion. Average thickness of metal in the bearing molds is 5 inches. In addition, many of the molds are reinforced with ribs on the outside. Incidentally it is essential that the molds shall be strong and rugged to withstand the rough treatment to which they are subjected over a comparatively long period. Manifestly a mold that costs several hundred dollars to produce must be utilized a good many times to justify its existence.

From four to six castings are poured from each large crucible suspended from the hook of a light traveling crane controlled from the floor. The metal sets almost immediately and the castings are knocked out by a gang of colored workmen who know exactly how much force may be exerted with safety. They also know the exact time limits to be observed. If the casting is allowed to remain too long in the mold the contraction will crack it. If the casting is handled roughly at a high heat it will crack. Long practice has rendered these men adept in gaging the time and in applying the tools in shaking out the castings. Usually a few taps from a sledge hammer to a block held against the long runner will release the casting from its grip on the mold.

Shrinkage is not a serious problem in this foundry on account of the character of the metal employed. Risers and feeding heads are employed to a limited extent but the great bulk of the castings are poured without riser of any kind. Heavy bushings, cored and solid, are poured under high heads as shown in Fig. 3. It is claimed that the pressure exerted by this form of pouring head insures solid metal in the casting without any auxiliary riser or feeder. The pouring heads are cut from pieces of 5-inch pipe and range in height from 6 to 8 inches. The runner opening is formed in green sand.

The heavy jobbing section which occupies space equivalent to four regular floors at the extreme south end of the foundry is equipped with several jib cranes located at strategic points in addition to a 2-ton electric traveling crane which embraces the entire section.

Equipment for making one of the smaller sizes of car journal bearings is shown in Fig. 5. Several floors are fitted in a similar manner. The patterns are mounted in pairs on heavy plates, one pair on the left for the drag, mounted on a squeeze roll-over machine; the other on the right for copes are mounted on a squeeze,

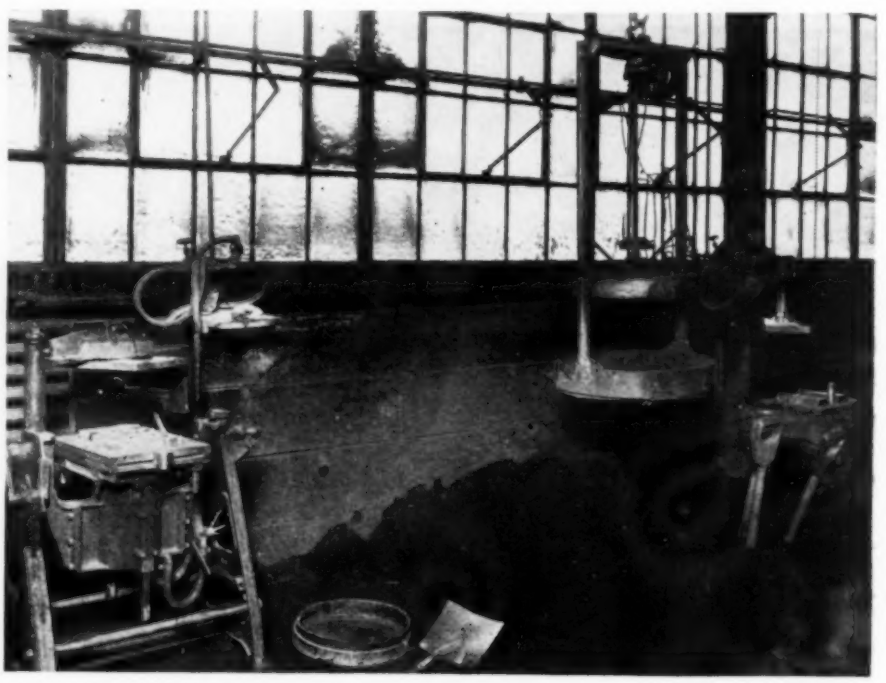


FIG. 5—ONE MAN MAKES DRAGS ON THE FLASK TO THE LEFT WHILE A SECOND MAN MAKES THE CORRESPONDING COPES ON THE MACHINE TO THE RIGHT

stripper plate machine. Six men mold, set up, pour, shake out and cut over the sand for 600 flasks per day.

Molds are set up on trestles for convenience in pouring. The melting and pouring routine is so arranged that a batch of molds is poured before the trestles are fully loaded. The castings are shaken out immediately after they are poured and either stacked in the gangway or loaded directly into containers of various types. Some boxes are mounted on low wheels and readily may be pushed from place to place. Others are mounted on skids and are transported on hand-operated lift trucks.

Sand is wet down and cut over by hand toward the back of the floor where it is passed through a rotary type riddle made by the Great Western Mfg. Co., Leavenworth, Kans. The riddle is suspended from a convenient hook and is operated electrically. Molds for these castings and for nearly all the castings made in this foundry are made in steel flasks supplied by the Truscon Steel Co., Youngstown, O.

Grooved trolley wheels for electric street car and similar service are made four in a flask, 190 flasks per day, by a molder and helper on a squeezer type molding machine supplied by the Arcade Mfg. Co., Freeport, Ill. This company also supplied the ladle pouring devices employed on the various floors for handling the metal.

Plain block patterns are used to form the mold. The green sand core for forming the groove is made in a corebox mounted on a stand close to the molding machine. The helper makes the cores at odd times between his other duties of placing molds on the pouring stands, shifting weights, shaking out the castings and cutting over the sand.

The metal corebox is in two parts, the lower part solid and containing a facsimile of the lower part of a trolley wheel pattern attached to it permanently. The upper part, corresponding to the upper part of a wheel pattern is loose and is fitted to the lower part by a male and female joint at the parting line in the center. A light metal ring, conforming on the outside to the shape of the core print on the pattern is employed for carrying the core. The shelf on the bottom of the ring fits snugly in a machined recess in the bottom of the corebox. The back wall of the ring is set at a slight taper to fit the core print in the mold accurately.

With the top half of the corebox and the lifting ring in place, the operator packs sand in the open space with his fingers. It is scraped off flush on top and then the top half of the corebox is removed. With this part out of the way there is nothing to prevent the operator from catching the ring at two opposite points and lifting it out of the box with the core an integral part.

The core room occupies a space in the northwest corner of the foundry and is equipped with two sets of coke-fired ovens made by the Swartwout Co., Cleveland. In one battery of four the cores are dried on 4 x 5 x 5-foot racks conveyed into and out of the oven by lift truck. The second battery of ovens is divided into 16 compartments, eight to a side, upper and lower provided with permanent shelves on which small cores are dried.

A fine silica sand used extensively by foundries of all kinds in the St. Louis district forms the base of many of the core mixtures used in this foundry and is used exclusively in the smaller and more intricate cores. Oil is used almost exclusively as a binder with a small addition of a dry binder in some instances. Limited quantities of molding sand and the spent sand from the sandblast department are added to the mixture where extremely high permeability is not required.

Castings are cleaned in two revolving sandblast barrels and in one 8 x 8-foot sandblast chamber made by the W. W. Sly Mfg. Co., Cleveland. The barrels, 4 feet in diameter and 4 feet deep are mounted at an angle of 45 degrees to the horizontal and are equipped with two doors. One, the full size of the barrel at the upper end through which the castings are loaded into the mill. The other considerably smaller is located in the circular part of the barrel close to the conical lower end. With the mill turned to the proper position, the castings fall through this lower opening by gravity into a waiting lift truck which conveys them to the chipping benches where they are trimmed to any necessary extent with pneumatic grinding and chipping tools.

One of the interesting departments connected with the foundry is shown in Fig. 4 where the journal bearings are lined with a softer metal. The castings first are bored on a special machine which handles them four at a time. Then they are dipped into a bath of molten tin which deposits a thin coating of tin on the machined surface. From the tin bath the bearings are taken in pairs and clamped upright against an iron core corresponding to the car axle. An attendant dips the lining metal out of a pot with a short handle scoop and fills the space between the bronze bearing and the iron core. Each filling station is operated by two men who have three pots at their disposal. One pot in the center contains the tin, while the lining metal is available in the other two. The supply is replenished at regular intervals and a thermometer is employed in maintaining the temperature at approximately 350 degrees Fahr.

All the metal-containing refuse from the foundry, ashes, skimmings, spills, etc., is treated in the department shown in Fig. 6. All the lumpy material first is reduced to a fairly small uniform size in the little crusher shown to the right in the illustration. The crushed material then is charged into the ball mill shown in the left background where it is pulverized and discharged upon two riffle tables where flowing water and specific gravity separate the metal from the dross which flows over the edge.

FIG. 6—ALL THE REFUSE IS CRUSHED, PULVERIZED AND WASHED TO RECOVER THE SCATTERED METAL

How and Why in Brass Foundry

By Charles Vickers

Checks Melting Practice

We are making bronze valve seats that weigh approximately 750 pounds each and experience some difficulty due to the appearance of small ragged specks after machine work has been done. These specks condemn the castings as the customer does not care to risk installing them due to the great amount of labor involved. We are sending a sample broken from one of the castings which shows the appearance of the fractured surfaces. The alloy used is composed of 84 per cent copper; 8 per cent lead; 6 per cent tin, and 2 per cent zinc, and the castings must withstand a pressure of 2000 pounds per square inch. We melt in open-flame type furnaces to a temperature of 2250 degrees Fahr., and pour between 2000 and 2050 degrees. We have tried double melting to no avail. Dry sand molds are used.

If the alloy can be changed we suggest the following: 82 per cent copper; 7.50 per cent tin; 5.50 per cent lead, and 5 per cent zinc. This is a better pressure resisting alloy than the one in use. The addition of 2 per cent nickel in place of that amount of copper also would be justified.

If the alloy cannot be changed, it must be melted more carefully. The type of noncrucible furnace mentioned requires care in adjusting the flame to avoid a smoky or reducing flame, and on the other hand a too strongly oxidizing flame. Any non-crucible furnace used in melting bronze or red brass that is run in such a manner as to deposit carbon in the furnace will cause much trouble in unsound metal. As shown by the fractured surfaces, this metal is unsound and under the magnifying glass this is confirmed. Use a slightly oxidizing flame in melting, and keep a thin covering of slag over the metal after it is molten. Glass makes a good slag for the purpose, but it must be a thin covering. Half an inch is plenty as a heavy slag causes cold heats. We have seen melters permitting several inches of slag on the metal, with the result of being unable to get their metal hot.

Bring the metal to 2300 degrees in the furnace and pour into the ladles on phosphor copper; 2 ounces of phosphor copper per hundred pounds of metal is ample to guard against oxidation. If the metal has been gassed due to using a reducing flame in melting, the addition of phosphor copper only makes the condition worse. If the metal is too hot when poured from the furnace it does not need to be poured into the mold, for a little stirring and a few minutes waiting helps the phosphorus in its work of sweetening the metal. The molding sand should be open, of a grade such as No. 2 Albany, and the mold should be vented on the bottom or drag half, but the vents must not be left entirely open for the metal to escape. From examination of the sample it looks as though all the trouble was due to the manner of handling the metal while it is melting, with particular reference to the use of a flame too much on the reducing side.

Has Too Much Manganese

We are making flat brass rings 14 inches in diameter and have trouble from dirt and hard spots. Can you tell the cause? We are sending a sample of the brass ring showing the dirt spots.

Dirt spots are caused by impurities in the brass, the two principal ones being manganese and iron. It looks as though some ferromanganese had gotten into the brass. The addition to a gun metal of 0.15 per cent of manganese is just about the limit to get good results, a little more and the metal will not run properly but will roll and enclose a light sepia-colored and tough skin in the brass which forms *cold shuts*. Iron-free manganese copper some times is used as a deoxidizer; which in the proper amount is superior to phosphorus for certain alloys of copper and tin.

As ferromanganese contains carbides of iron and manganese, which will not mix with copper, ferromanganese is harmful in brass, with particular reference to red brass. The carbides segregate and produce hard spots. As some manganese is dissolved it works harm by promoting segregation of the constituents of the alloy, thus producing a fracture known as *mixed*, that is consisting of different colors like that of the sample submitted. Also it produces the cold shuts mentioned above and which are shown in the sample also.

Gating Is Wrong

We are having difficulty due to losses in making red brass mud plugs for locomotive boilers. A considerable number of the castings contain pin holes or cavity runs in the gate which are not apparent when the plugs are inspected and ground at the foundry, but are uncovered when machined. This causes leakage of the plugs. The mixture is 85-5-5-5 made from selected red brass scrap which is first ingoted in a noncrucible furnace, each heat being analyzed and in the subsequent melting brought up to standard. The white metals are added in the ladle. We use charcoal and borax in each ladle and pour at approximately 2100 degrees Fahr. The pattern equipment consists of aluminum plates with ten plugs in a mold; the runners are in the cope, gates in drag and the gates are filletted at juncture with plug body. Of the two samples sent you; one was poured at 2375 degrees Fahr. and the other at 2000 degrees Fahr., and the metal was heated to 2400 degrees in the furnace. Both castings are poured from the same ladle of metal. Both castings had a 7-inch head of metal figured from the parting line of the mold.

The metal is good and sound showing that the furnace practice is good so melting is eliminated from further consideration. The difficulty is entirely due to mistaken methods of gating the castings and it will persist regardless of anything that can be done until the patterns are rearranged on the plates and are gated properly with an understanding of what is necessary to offset the shrinkage of such metals. More metal will have to be put into the gates, so there will be much more remelt, but this extra cost can be offset by buying ingot metals.

Ounce metal is not an exceptionally good alloy, and with tin at present prices a saving can be made by adjusting the alloy a little. This would compensate for the extra remelt necessary to get sound castings. Not that such remelt can be dispensed with as it has to be done. It may not have been figured on when bids were made, therefore, we point out how this extra cost may be absorbed.

Cast Iron Is Improving

High Silicon, Low Carbon Cast Iron Is Produced in the Cupola —Superheating and Jolting Said to Exert Beneficial Effect

By Edwin Bremer

Part III

ANOTHER method of producing a high quality cast iron in the cupola is known as the Thyssen-Emmel process. The iron, produced in a similar manner to the Lanz method, is of low carbon content, but differs greatly in the silicon content, being nearly twice the value. Manganese also is considerably higher. One analysis given for this iron is: Total carbon, 2.64 per cent; combined carbon, 0.83 per cent; silicon, 2.14 per cent; sulphur, 0.159 per cent; phosphorus, 0.25 per cent; manganese, 1.37 per cent. Just what procedure is carried on in the Thyssen-Emmel process to obtain a total carbon of 2.64 per cent, is not revealed. It may be that such an analysis might be obtained by using an all steel scrap charge with additions of ferromanganese and ferrosilicon briqueted directly with the steel or with some material that will not melt until the melting zone of the cupola is reached.

Experiments have been carried on in Germany to lessen the activity of the coke charge and thereby produce low carbon metal in the cupola, as well as attaining a greater temperature in the melting zone. Gilles in *Die Giesserei Zeitung*, April 15, 1926, states that in some experiments he used coke that had been dipped in lime water. He found that the coke reached the melting zone unburnt and obtained a temperature above 1500 degrees Cent. in the spout of a 5-ton cupola without a forehearth.

Superheat Is Beneficial

While considerable stress seems to be placed on the production of a pearlitic structure, the distribution and size of the graphite particles probably determine the strength of the iron, considering only carbon. Foundrymen know well that when graphite is distributed through the iron in plate-like form, the iron is soft and does not have great strength. However, when the graphite is in fine particles and well distributed through the metal, the iron is much tougher and is much stronger.

Foundrymen also have recognized that the hotter the iron is melted in the cupola, the better the resulting castings. Piwowarsky has confirmed this theory by an extended investigation into the effect of superheating on cast iron. The results he obtained are presented in the April 1 and April 15, 1927, issues of THE FOUNDRY. Piwowarsky found that superheating molten cast iron led to a uniform, fine dissemination of graphite instead of the plate-like form. From results he obtained it was shown that the rate of cooling and the degree of superheat exert an equally direct influence upon the position of the eutectic temperature. Higher degrees of superheat gave a rapidly increasing retardation of solidification below the freezing points of the heats, and this according to Piwowarsky supplies an explanation for the mechanism of graphite subdivision as superheat increases.

Employs High Temperatures

He used temperatures of superheat up to 2900 degrees Fahr., and stated that at this temperature molten iron, as far as graphite formation is concerned, becomes much less sensitive to changes in the rate of cooling or what is the same thing, it is less dependent upon the thickness of section. It will retain the finely divided graphitic structure even with slow rates of cooling (heavy section).

Deschesne, Feurstenau and Irresberger. THE FOUNDRY, Oct. 1, 1926, carried out an investigation of the effect of jolting molten cast iron at Berlin-Spandau, Germany, and found that by thorough agitation of freshly tapped molten iron, desulphurization took place. It is claimed that as much as 55 per cent of the original sulphur content was removed by this method. The apparatus used for jolting consisted of a refractory-lined receptacle which was placed at the cupola spout. The part of the box or receptacle nearest the cupola was mounted upon an axle and the other end was lifted about 1½ inches by a cam action at the rate of 100 jolts per minute. Another feature claimed for this method is the prevention of the formation of large particles of graphite, with a resulting fine structure promoting solidity and better physical qualities. Tensile strengths of 42,600 to 56,800 pounds per square inch; bending strengths from 71,100 to 85,300 pounds per square inch and a deflection of 0.6 inch with supports 23.6 inches apart, and bars 1.8 inches in diameter are reported. Bars 0.6 inch in diameter under the same conditions attained bending strengths up to 163,500 pounds per square inch with deflection of 1 inch. Brinell hardness lies between 180 and 240.

Add Steel Scrap

Additions of steel scrap to the cupola charges have been advocated for some time. Probably the first to place this means of improving the physical properties of cast iron on a commercial basis was David McLain. However, unless careful cupola practice is observed and the molten metal mixed thoroughly before pouring, poor castings may result. If these simple precautions are observed, excellent results will be obtained. A. J. Meissner, THE FOUNDRY, March 15, 1928, using 20 per cent steel rail ends in the cupola obtained tensile strengths from 40,800 to 43,780 pounds per square inch. He stressed the importance of using selected raw materials to obtain the best results in physical properties. Analysis given by Meissner are as follows: Sample No. 6—silicon, 2.04 per cent; sulphur, 0.092 per cent; manganese, 0.57 per cent, and total carbon, 3.22 per cent; transverse strength, 4461 pounds per square inch; tensile strength, 40,800 pounds per square inch. Sample No. 2—silicon, 2.01 per cent; sulphur, 0.082 per cent; manganese, 0.56 per cent, and total carbon, 3.15 per cent; transverse strength, 4634 pounds per square inch, tensile strength, 43,780 pounds per square inch.

Greenhow, THE FOUNDRY, Dec. 1, 1927, used all steel scrap charges in the cupola with ferrosilicon. Ladle additions of ferromanganese, ferrosilicon and ferronickel were made to obtain certain physical properties. He used a 36-inch cupola with an initial coke bed of 40 to 50 inches above the tuyeres. After the bed was in-

candescent throughout, six inches more of coke was added and the charging commenced. The stock was allowed to soak for at least one hour and preferably two. The metal charge in the cupola was 1000 pounds and consisted of coil springs. Fifteen pounds of ferrosilicon was added in the cupola to provide most of the silicon necessary to meet the requirements. Ladle additions of 12 ounces of 70 per cent ferromanganese; 8 ounces of 50 per cent ferrosilicon, and 24 ounces of ferronickel were made for each 100 pounds of molten metal. The air blast is given as 14 inches of water pressure or 7.85 ounces per square inch.

Data as presented by Greenhow follow: Heat No. 5—silicon, 1.68 per cent; sulphur, 0.073 per cent; phosphorus, 0.11 per cent; manganese, 1.13 per cent; total carbon, 2.73 per cent; nickel, 0.98 per cent; transverse strength 4900 pounds per square inch; deflection, 0.17 inches; brinell hardness, 228, and tensile strength, 48,465 pounds per square inch. Another test that ran higher in tensile strength showed 1.41 per cent silicon; 0.096 per cent sulphur; 0.13 per cent phosphorus; 0.88 per cent manganese; 2.86 per cent total carbon; 0.97 per cent nickel; transverse strength, 5210 pounds per square inch; deflection, 0.24 inch; brinell hardness 217, and tensile strength, 52,600 pounds per square inch.

Uses High Blast

Gilles, *Foundry Trade Journal*, Dec. 30, 1926 (abstract in THE FOUNDRY, Feb. 15, 1927) describes the process developed by Corsalli in Germany. The cupola used differs from the ordinary one in that it has an auxiliary apparatus consisting of a pipe or tube built on the outside of the cupola. This tube enters the cupola at a point just above the tuyeres and extends vertically to a point in the stack considerably above the charging floor. An opening closed with a flap door is on a level of the charging floor.

This auxiliary apparatus is for the addition of the ferroalloys that are added to the charge. The charge or mixture consists of two-thirds steel or wrought iron scrap and one-third runners and risers, and other scrap from the preceding heat. The ratio may be greater or smaller according to the nature of the castings. The charge has approximately the following analysis: Carbon, 1.0 to 1.2 per cent; silicon, 0.6 to 0.8 per cent; manganese, 0.3 to 0.4 per cent; phosphorus, 0.2 to 0.3 per cent, and sulphur, about 0.03 per cent. About 0.8 to 1 per cent silicon in the form of ferrosilicon is added with the charge and the necessary balance of silicon and manganese is fed into the bath in molten form by use of the auxiliary melting apparatus heated by the ascending gases.

Fuel is Westphalian foundry coke coated with lime sludge. Maximum charge coke is 10 per cent, and the blast volume is one and one-half to two times as great as in ordinary cupola operations. Due to half the silicon and the major portion of the manganese being added through the auxiliary apparatus, the total silicon loss is from 15 to 20 per cent, and the manganese loss is about 10 to 15 per cent. Carbon absorption from coke materially is reduced by the high blast employed. Sulphur rarely is above 0.12 per cent. Several analyses of the finished product are given and range as follow: Silicon, 1.97 to 2.44 per cent; sulphur, 0.09 to 0.12; phosphorus, 0.24 to 0.28 per cent; manganese, 1.23 to 1.45 per cent and carbon, 2.64 to 2.82 per cent.

Iron Is Hot

Temperature of the iron when it leaves the cupola is 1480 to 1500 degrees Cent. It also must be poured hotter than normal cast iron, owing to its low carbon and phosphorus content. For thin-walled castings the phosphorus should be raised to 0.5 to 0.6 per cent. Physical properties for metal produced by this process range as follow: Tensile strength, 48,900 to 55,600 pounds per square inch, and deflection, 0.35 to 0.45 inch.

Considerable argument has been presented in the German and English technical press on the value of a wholly pearlitic structure and the methods of obtaining this structure. As has been pointed out, the value of the various processes perhaps does not lie so much in the fact that a pearlitic structure is the determining factor in obtaining a high duty, strong iron, but for the reason that the low total carbon and high superheat of the metal cause the graphite to be finely and uniformly distributed through the matrix. Another feature that seems to be overlooked to some extent is the low phosphorus content of the castings produced by these various methods. Low phosphorus content in cast iron long has been recognized as a method to secure high impact value due to phosphorus promoting brittleness under shock. Sulphur no longer seems to be regarded as a bugaboo as in most cases noted, analyses of the irons show that the sulphur is well over 0.100 per cent and in some cases around 0.150 per cent.

For any process to be useful to the average foundry, the cost factor must be relatively low. It is unfortunate, but nevertheless true, that no matter how high the quality of the iron, the many consumers only consider it as cast iron, in their minds a cheap product, and will pay for castings on that basis. Considerable effort and expense are involved in educating the consumer to the value of quality castings at a price which allows a reasonable profit. When consumers are willing to pay a reasonable price for high grade castings, foundrymen can afford to install electric furnaces or perhaps use one of these new processes, such as the Lanz with its added expense of heating molds and perhaps special irons, but in this country at present, the cost factor militates against employing these methods.

Therefore, it seems to be up to the foundrymen to develop a less costly process to obtain cast iron that will stand up under hard usage. Developments in the engineering field in the use of high pressure and superheated steam, in the diesel engine with its high temperature and pressure, and other machines demanding castings of high strength and resistive powers, should awaken the foundryman to the need of producing a high quality iron at a low cost. Further investigation and research may go even deeper and discover a method for producing a graphite eutectic which German metallurgists claim is the ultimate aim.

Institute to Hold German Meeting

The council of the Institute of Metals of Great Britain has accepted a cordial invitation from the Verein Deutsche Ingenieure and the Deutsche Gesellschaft fur Metallkunde to hold next year's autumn meeting of the institute in Germany. The meeting will take place in Dusseldorf. It is expected to prove attractive, not only to British members but also to members resident in continental countries, who number many hundreds. The latter often find it difficult to attend meetings in the British Isles, but —as was proved on the occasion of the institute's gatherings held in Ghent and Liege—they come freely to meetings held on the continent. Dusseldorf is so readily accessible and so full of metallurgical interest that the meeting in that city—the first to be held in Germany by the Institute of Metals—is certain to be well attended and successful, supported as it will be by powerful German technical societies and by a large and enthusiastic German membership.

Base Bonus on Scrap Control

This System Slightly Increases Molding Prices Per Piece, but Indirect Savings Are Effected Which Overbalance Increased Molding Cost

By R. J. Teetor

WAGE incentive plans are based on a desire to speed up production and thereby lower the cost per unit from a labor and capital investment standpoint. All plans are effective, and some of them show excellent results.

A satisfactory plan now in use resulted from the consolidation and modification of two plans, each of which showed some value, but also some disadvantages. The first plan employed, aimed at increased production only. No consideration was given to scrap percentages. It operated as follows: Piece rate for the job was established. A normal rate which an average molder should be expected to earn was established as 50 cents per hour. The bonus consisted of the addition of 100 per cent to any earnings in excess of the normal expectancy of 50 cents per hour.

Example

	Cents per hour
Molder's average wage for ½ month	58
Normal expectancy rate	50
Difference	8
We added bonus of	8c
Making total pay	66

Under this plan it was necessary for the molder to work consistently each day to earn a bonus. He could not profitably work at a high rate for a day or two, earning an excessive bonus, and then let down for a period to rest, because his hourly earnings were computed for the entire half month at full time daily. However, the plan put no premium on percentage of good castings and had the effect of speeding up the making of molds with a lowering of percentage of good castings. The molder worked faster, but no more carefully, in the hope that he would get enough good work out to earn a bonus. The plan was weak also because the loss of a day or two deprived the molder of any bonus.

The second plan evolved jumped to the other extreme, and offered a bonus based upon good percentage average for the ½ month without regard to total amount of production or regularity of attendance. The bonus took the form of a percentage of total pay for the ½ month, based upon percentage of good castings. Under 85 per cent good, no bonus was earned. Eighty-five per cent good entitled the molder 10 per cent of pay for his bonus. Eighty-six per cent allowed him 12 per cent, and so on up to 100 per cent good, which would entitle him to 48 per cent of pay for his bonus.

Reduced Scrap

This plan was weak because the incentive for larger production was overshadowed by the incentive for a high percentage of good castings. It had the effect of reducing scrap to a fairly low figure; but apparently made the molder ultra-conservative, and slowed him down to a low production rate.

After a few months trial of this second plan we worked out a schedule which has been in effect during the past 2½ years and which has been found practicable, embodying the good points of the earlier systems, and eliminating the disadvantages.

Each pattern is given a piece rate and the number of molds to be produced daily as a normal day's work for an average or fairly good molder. If the molder exceeds this normal day's work for a sustained period of one-half month, he receives payment for his excess above the normal average day's work at double the regular piece work rate. The molder is notified of the piece rate and the number of molds he must produce daily to be entitled to any double pay. These figures never are revised downward unless a change in pattern equipment justifies such change. Sometimes they are made more liberal when we are convinced the piece rate has been established too low, or the doubling figure so high that the average man ordinarily cannot participate in the double rate.

Example

Rate per mold	5c
Normal days production	100 molds
Normal days pay	$5.00
Molder actually produces	120 molds
Normal days production	100 molds
Molds produced above normal expectancy	20
20 molds at double rate, or 10c	$2.00
Molder's pay is therefore	$7.00

The bonus is based purely upon percentage of good castings and regularity of attendance. The schedule follows:

Percentage of good castings produced	Bonus in per cent of regular pay
Up to 90	No bonus
90 to 91	10
91 to 92	12
92 to 93	14
93 to 94	16
94 to 95	18
95 to 96	20
96 to 97	22
97 to 98	24
98 to 99	26
99 to 100	28

Bonus Plan Works

THIS bonus plan has been in use at the plant of the Cadillac Malleable Iron Co., Cadillac, Mich., for the past two and a half years and has proved successful in providing an incentive in two directions, one, by encouraging the molders to work continuously and to obtain high production and the other by encouraging a low casting loss. Regular pay is based on a normal day's work and the molder is given double the regular rate for everything over the normal day's work. The bonus for reduction of scrap loss starts at 90 per cent and a molder having good castings to the extent of 90 to 91 per cent of his heat gets a bonus of 10 per cent of his pay. This percentage increases to 28 per cent for 99 to 100 per cent good castings. The company finds that on an average it pays 8 per cent increase on the regular pay on account of greater production and the molders draw an average bonus of 10 per cent for scrap reduction. This article is abstracted from a paper presented at the recent convention of the American Foundrymen's association in Philadelphia. The author R. J. Teetor, is secretary and general manager of the Cadillac Malleable Iron Co., Cadillac, Mich.

Only molders working full time during the pay period receive full bonus.

Men absent ½ day receive 2/3 bonus

Men absent 1 day receive 1/3 bonus

Men absent 1½ days receive no bonus

Bonus is paid with a separate check. The regular pay check presumably goes to the wife for living expenses. The molder, with a fairly clear conscience, can put the bonus check in his own pocket for his personal use.

Employers liability insurance premiums are calculated upon the regular pay only, and not upon the bonus. The latter is not paid for increased production, but for better quality of product.

Molder's pay and bonus are given publicity. Daily reports are posted on bulletin board showing molder's percentage, good and bad. Semimonthly sheets are posted showing

Hours worked by each molder

Average hourly rate of pay for each molder

Total pay for each molder

Bonus hourly addition for each molder

Total bonus for each molder.

Speed Production

This publicity has the effect of stimulating less experienced molders to put forth greater effort, and inducing good spirited rivalry among the more experienced men. Average extra pay, or double pay, is 8 per cent in excess of the regular piece rate pay. And the average bonus is 10 per cent making a total of 18 per cent. However, as molders earnings represent but 11 per cent of total cost, this increase of 18 per cent due to bonus and double pay represents an actual addition to overall cost of but 2 per cent.

Against this 2 per cent apparent increase in cost we have found savings ten times as great.

These savings result from

Reduction in remelt

Reduction in hard cleaning cost

Reduction in trimming and inspection cost

Reduction in grinding cost

Reduction in anneal cost

Reduction in soft cleaning cost

Reduction in soft inspection cost

Increase in production per molder

which reduces all overhead fixed charges per ton of good castings produced.

The plan also has greatly reduced labor turnover.

Industrial engineers tell us our method is wrong because it actually increases the molding price per piece, instead of decreasing it. That is true, but it has brought about the indirect savings mentioned which overbalance the increased molding cost about ten to one.

We believe too that the trend of compensation for molders and all other labor whether skilled or unskilled is definitely set in the direction of participation in as large and as accurately computed a share as possible of such savings as can be directly traced to their conscientious efforts. Furthermore we are in thorough accord with this trend, and think it an economically sound policy.

Coal Facing Responsible for Smooth Skin

Question: We are enclosing blueprint of two small charcoal braziers or fire pots, one round *A*, one square *B*, also a small cooking pot of the type used in Central America and the West Indies. At present these castings are supplied by American and Belgian firms and we note that the Belgian castings are lighter and smoother than those made in the United States. We are contemplating the manufacture of these castings and as they are not sold by the pound we should prefer duplicating the Belgian rather than the American product. We shall appreciate any imformation you can furnish on the pattern equipment required and also the daily output of a molder whether working on a bench or a molding machine.

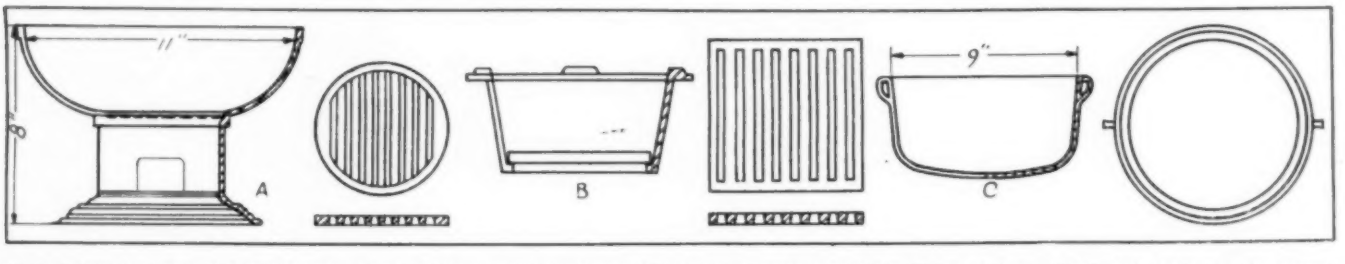
Answer: We know of only one place in the United States where these castings are made for South and Central America and the West India islands. The foundry is located in a penal institution and operated by convict labor under contract with the state. We do not know what your operating costs are but we question whether you could compete on this class of castings. Your freight bills on the coke and iron required to make the castings will amount to more than the freight on the finished castings.

Hollow ware is made in several foundries in this country, but so far as we know it is molded and rammed by hand. Beyond the usual iron pattern and follow board no special equipment is employed. An illustrated article covering practically every feature in connection with the manufacure of this class of castings appeared in THE FOUNDRY. April 1, 1921. The pots are made in wooden flasks and a fine grade of sand is employed. A considerable degree of skill is required on the part of the molder to judge properly the degree of density to which he must ram the sand at diferent points on the mold. The output varies, depending on the size of the casting. On the size shown on the blue-print the average molder will make 60 castings and that includes cutting his sand, pouring the castings and shaking them out. The smooth skin is imparted to the casting by mixing sea coal with the facing sand in the proportion of 1 part of coal to 10 or 12 parts of sand. The principal objection to its use is that it retards the flow of the iron to a slight extent and, therefore, unless the castings are poured with exceedingly hot iron, cold shuts will appear on the surface.

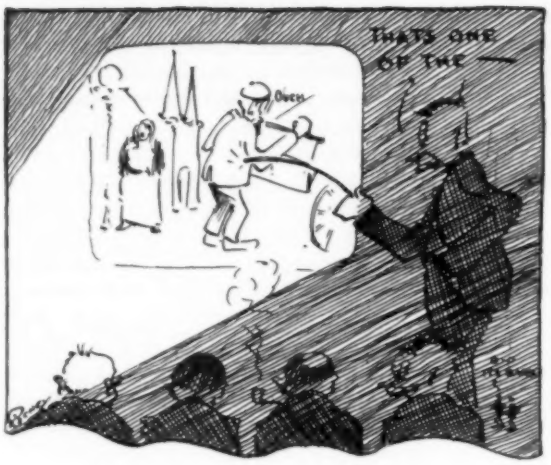
Hold Summer Outing

The July outing of the New England Foundrymen's association was held Wednesday, July 11, at Worcester, Mass. The day was given over to sports, entertainment and shore dinner. Fred S. Newcomb, Pilling & Co., Boston, was the general chairman.

Crown Smelting Co., Chester, Pa., has a contract from the government for 20 manganese bronze propellers for scout cruiser service, totaling about $75,000.



THE ROUND TYPE OF FIRE POT AND GRATE ARE SHOWN AT *A* AND THE SQUARE TYPE AT *B*. SECTION AND PLAN VIEW OF THE COOKING POT ARE SHOWN AT *C*



Bill Touches on Some Problems in Molding-X

By Pat Dwyer

ONE night recently Bill and I had the pleasure of attending a dinner in a downtown hotel followed by an illustrated talk by a gifted and courageous young lad who had just completed a journey around the world. By gifted I mean he had the happy faculty of pouring forth his description in nicely chosen words and in a continuous stream. No one will quarrel with the term courageous when I explain that he started without any money or other material resources and his financial status was the same when he finally made the old home port of Cleveland.

If I was in a reflective mood I might stop at this point to moralize on the fact that thousands of people dream for years on the prospect of making a tour round the world, but never realize their ambition because they feel they cannot spare the time, because they never can gather together the necessary funds, or both. Without doubt what Bill calls a comfortable wad of Jack would ease the rough places and throw oil on the troubled waters, but the journey can be made without it if one is satisfied to live the simple life like the birds of the air, dear little innocent creatures who know nothing of time clocks or paydays. The young man's idea of going around the world did not spring forth full grown, lusty and strong. It began innocently enough in a casual invitation extended by a fellow student to accompany him to Montreal in his father's private car. Both lads had just graduated from college and our hero felt that he could spare a couple of weeks on a pleasure jaunt before tendering his highly important services to some old fossil whose business needed the injection of a goodly supply of fresh young blood. Up and away for a couple of weeks' rest and recreation and then back to the job full of vim, vigor and vitality! He would show them a thing or two in the way of grabbing a fancy hold on the tail of the world on a downhill pull.

He had to revise his opinion in many respects before the tour was over, but that is such an ordinary experience, extended reference is not necessary. Let us continue, dear children, on the wide road, the open road that leads to the far and ever receding horizon, where the grass is greener and the cows' horns longer (oh, ever so much longer) than it or they, is or are, in our own familiar pastures.

In the wicked old days before the eighteenth amendment had purified the nation and while the demon rum still stalked abroad in the land, little boys constantly were warned of the danger that lurked in the first glass. One drink inevitably led to another and before the victim realized his danger he found himself shooting at a mile-a-minute clip on a pair of greased skids toward the brink of the—ah—well known bottomless pit.

Apparently the same rule holds with travelers. The first jaunt sets up a craving for just a little more. Our hero had no intention of going beyond Montreal when he started out, but the fatal appetite led him farther and farther, until finally he reached a point where the journey home represented the same distance whether he traveled east or west. He took counsel with himself, but he heard the East a-callin' an' the sound of paddles chuckin' from Rangoon to Mandalay. He tightened the belt another notch and held on toward the rising sun.

Had he remained safe and snug in the private car he might have resisted temptation. This is a nice point and one that cannot be decided off hand. After the meeting I mentioned it to Bill and claimed that if the lad's curiosity had not led him down to the magnificent stone docks along the river he never would have gone on the adventure.

Bill held to a different opinion and quoted incidents from his own experience to prove that a short journey fans the wanderlust flame lying dormant in many people. "Once the old bug gets a grip," he said, "and the dogs begin to get itchy, you'll never rest until you're on the way. If this lad had not sailed for Europe he would have joined an exploring party headed for the Hudson Bay country, or he would have shipped on a flying fisherman out of Gloucester and learned at first hand how filet of sole, boneless cod, kippered herring and other finny denizens of the deep look while they still are as you might say, on the hoof." What's the use of arguing with a man who drags in piffle of that kind? In fact all the arguing from the rising of the sun until the going down of the same

BLESS THE LITTLE PETS' HEARTS. THEY ARE SO PLAYFUL

jolly old luminary will not alter the fact that our hero took the second fatal step when he went prowling down around the docks. He met another young gentleman of leisure down in that vicinity engaged for the moment in the peaceful occupation of watching the water flowing from the bronze fountain near the sailors' haven.

Over a borrowed friendly cigaret, the second young man confided that by the rarest stroke of good fortune he had secured a free passage to Europe. Pressed for particulars he admitted that he had agreed to perform certain light duties incidental to the welfare of a drove of cattle on the way across. Nothing arduous, you understand, but just about enough to keep a strong, healthy young lad in good physical trim. He was not quite sure if any vacancy remained, but if his friend would accompany him, he would speak to the mate and use his influence in securing him a berth. By a curious coincidence the mate needed one more hand and graciously was pleased to sign our hero on as a member of the crew. Before the pounding old engines of the TADOUSAC had driven her to the mouth of the river our amateur sailor decided that the mate was an optimist. Instead of signing on one hand he should have taken a dozen. Passing Anticosti and St. Pierre he debated earnestly the advisability of slipping overboard with a life preserver. Temperature of the spray from a slashing wave which drenched him to the skin, knocked that idea out of his head. Arctic currents sweeping down through the strait of Belle Isle might suit seals and walruses, but he was quite certain they would convert him into a useless icicle. Long before the old tub had rounded Cape Race and straightened away for Liverpool he began to hope she would hit an iceberg, sink with all hands and feet and put him out of misery. Certainly he vowed never to go on another voyage.

Without going too deep into particulars it is sufficient to say that the mate cured him of these gloomy forebodings. Mates are wonderfully gifted in this respect. If they were not so gifted only a comparatively small number of vessels ever would reach their destinations. Curiously enough the patient entertained no feeling of gratitude for his savior. He cheerfully jumped the ship in Liverpool and down to this day he cherishes the most violent antipathy for a cow and a first mate. He claims that the smell of one and the sight of the other makes him sick.

When he shipped out of Montreal he intended to make a short dash through merrie England and then catch a working passage of some kind back to his native land. His experience on the outward voyage cooled his enthusiasm. The deadly wanderlust virus also was permeating his system and he decided he might as well take a look at Paris.

Through a chance acquaintance in the French capital he got in touch with a newspaper syndicate which agreed to pay him a modest honorarium for short descriptive articles to be written here and there throughout Europe. With an assured, if modest, income at his disposal he decided on an extended tour. If big business in his homeland had existed all these years without his assistance he felt it might be trusted to struggle along at least until the first of the year. Christmas was set as the dead line when he should sail for home. He expected to be filled up by that time.

HE COULD GET IT WITHOUT ASKING A COP

He secured a small moving picture outfit and set out systematically to collect souvenirs of the grand adventure which carried him through France, Spain, Italy, Switzerland, Germany, Holland, once more into England and back through France. Christmas found him in Marseilles searching for a ship on which he might exchange the services of a stout heart and a willing hand for a passage to any port on the Atlantic seaboard of the United States. He found that boats for *Les Etats Unis* were few and far between and every one carried a disgustingly full complement of crew and passengers.

Providence, which up to that time never had deserted him, again came to the rescue with a ship. True, she was not much of a ship externally or internally and the prospect of sharing the deck with a miscellaneous assortment of pigs and poultry was not particularly alluring. The fact that she was bound for Algiers, Alexandria and Cairo was dismissed as a factor of minor importance. "Out of France by Christmas," had been his slogan and he was living up to it. Also, he quieted his remnant of a conscience by the reflection that perhaps never again if he passed up this providential opportunity, would he have the chance to see the ancient and mysterious land of Egypt. All of which, dear children, just goes to show how yielding to the first temptation, greases the skids, lowers the resistance and tensile strength and increases the elongation. By this time he was a long way from home and going farther every day. Delightful climatic conditions in the Delta led him on a more extended trip up the Nile where he found the Sphinx, the pyramids and the massive ruins of ancient temples quite up to expectations. On the return journey he decided to abandon his former system of careful planning and be guided wholly by chance. If he found a boat going west he would take it. If the first available boat was going east, why, that would be fate and who was he, a mere mortal, to resist? Allah is great and Mahomet is his prophet!

Apparently, to employ a colloquial phrase, Mahomet was on the job. He (our hero, not Mahomet) shipped on a small steamer bound for Calcutta. With the exception of a German student who also was a bit of a prowler, the remainder of the crew were Arabs, but they were first rate sailor men and the journey was made without any particular incident outside of ordinary routine.

He saw Bombay, Madras, Delhi, the Taj Mahal and the sacred city of Benares on the Ganges where the pilgrims are purified for a trip to paradise. Our hero did not take a dip in the glorified open sewer. The prospect of a free pass to paradise was rather alluring, but since he

heard of no intermediate station where candidates were subjected to a rather thorough fumigation process he was quite sure the realms of bliss were no place for any person with a sensitive nose.

Afterward he visited Singapore, Straits Settlements, Hong Kong, various points in China and Japan and then worked his passage on an old windjammer from Yokohama to San Francisco. The remainder of the journey across two-thirds of the United States was made partly as a passenger and partly as a fireman in the cab of various locomotives.

"It is a great pity," Bill said on the way home, "that the lad is not a foundryman. Just think of the inside dope he could have given us on the foundry practice in foreign countries. I have seen pictures of huge and marvelous castings made in the Far East, but I never have heard or read a first-hand description of how the work was done. If you don't mind I'll present a few more comments on the trough casting we were discussing recently. Detail of making, gating and pouring the mold either in green or dry sand has been touched upon, therefore there is no occasion for taking up these features again. Procedure is the same whether the casting is molded bottom side up as in former descriptions, or, bottom side down as in the method now under consideration. Present description is only concerned with the various methods of making the core and holding it in place in the mold.

"In the first three of the four methods outlined either the pattern or an independent corebox is employed and the core is made in a section of the foundry set apart for that purpose. Under certain circumstances one man makes both mold and core, but the usual practice is for the molder to make nothing but the mold, while the core is made by a second workman who specializes in that branch of the trade. In the fourth method, sand to form the core is rammed in the pattern while it is in the floor. The body of sand is suspended from the cope of which it forms an integral part. Cope and core are lifted as a unit. In this instance the molder attends to all details. The fourth method calls for a higher degree of skill on the part of the molder, than any of the other three.

"On account of the drying time involved, the core is made before the mold in the first two methods on the list. In the third method this feature is optional. The green sand core may be made either before or after the mold. If an independent corebox is employed core and mold may be made simultaneously by two men or two groups of men. In the fourth method of course there is no option. The core really forms part of the cope and is built immediately after the sand on the outside has been rammed to the top of the pattern.

"Reinforcement of some kind is required in each of the four types of cores. Several individual lengths of pipes and rods will serve the purpose in the dry sand cores, but the green sand cores require something more elaborate and substantial. The dry sand block will withstand rough handling and the pressure from the molten metal with a minimum amount of reinforcement, but the green sand core offers practically no resistance of itself, therefore it must be braced artificially and reliably so that it may retain its shape against the pull of gravity and the pressure exerted later by the metal.

ON THE ROAD TO MANDALAY-AY HEY! HEY!

"Where a large and assorted collection of pipes and rods is available, the coremaker usually experiences little trouble in making a selection to serve his purpose. However, in many instances he finds it more convenient and economical to cast an arbor in an open sand mold. The time involved is trifling, particularly in shops where a level bed is available at all times. The iron costs practically nothing, since it is returned to the cupola after it has been removed from the casting. For comparatively shallow castings the arbor or crab takes the form of a plain frame with steel loops cast in at suitable points. The loops are employed for lifting the core into the mold and for attaching it to the cope or other support in the event chaplets are not placed under the bottom. On deep cores tre arbor is provided with long dabbers which hold the sand in position and prevents it from sagging before and during the drying period. This form of arbor sometimes is employed in a green sand core, but usually a more elaborate form is employed, particularly if a number of castings are ordered or in prospect. Description of this type of arbor will be taken up later in connection with the green sand core.

"Having outlined the various types of cores and their application in a general way, let us now take each one in turn and consider it a little more in detail. The first is a more or less solid dry sand core. Thus the inside of the core may be filled with coke and old sand, or, the core may be made as a shell with a bottom, sides and ends. The idea in using this form of construction is to economize on core sand, also on the amount of heat required to dry the core. The walls of the shell stand up readily where an arbor with long dabbers is employed. Care and skill on the part of the coremaker are required where this type core is reinforced with individual pipes and rods.

"The pattern (or corebox if one is available) is placed on a straight, flat core plate located either on the floor of the core room or on one of the core oven cars. The advantage of building the core on the car is that after it is finished it is ready to go in the oven without any of the jar or risk incident to lifting it from the floor to the car. Also in some instances a number of small plates may be assembled on the car for a foundation, instead of the one, large, special plate required where the core is made on the floor.

"A strong, heavy plate properly ribbed on one side and planed on the other side, justifies its expense where a number of cores are required, but ingenious makeshifts usually are employed where a single casting is ordered. In the instance just cited where two or more plates are employed instead of one, any unevenness or ridges on the bottom face of the core easily are rectified with a brick and a straightedge, after the core has been removed from the oven and while it is hanging suspended from the crane or from the cope and before it has been lowered into the drag to remain.

Mounting a Cover Pattern

Interesting Details Are Presented of the Manner in Which Two Metal Patterns Were Mounted to Serve, One for the Cope and One for the Drag

By H. N. Tuttle

THREE views of a cover casting about 12 inches long and 5/32-inch thick are shown in Figs. 3, 6 and 7. This cover had been made for some time as a die casting when decision was reached to cast it in gray iron. Since the shrinkage was not an important factor, two die castings were pressed into service for patterns under the new dispensation.

This easy method of securing a pattern not always is available. For patterns of this general description, extremely thin metal where the slightest shift will cause a misrun, a shell master pattern in the stove plate style is preferable to the usual pair of patterns, one for the cope and one for the drag. The following description of the method used to insure a perfect match is applicable to all this class of patterns.

On account of local conditions the cope pattern was mounted on a hand stripper while the drag was rammed and rolled over on the floor by hand. This method is practiced extensively in this particular foundry and yields satisfactory results. Also machine and flasks were available.

Use Different Pins

A view looking down upon the hand stripper is shown in Fig. 2. A round pin was used at one end and a flat pin was employed at the opposite end to prevent error in closing; also to prevent any tendency of the cope to jerk or stick while descending on the drag. Instead of placing the gates flush with the edge of the casting where they might break in, they were raised upon block *H*, Fig. 2. The position may be noted more clearly at *H*, Fig. 6. Generous disposition of gates as shown at *J*, Fig. 2, insured ready entrance of the metal into the mold and consequent absence of misruns and coldshuts. The sprue was kept back a safe distance as shown to prevent the sand from caving under the pressure.

To prevent a fin at the openings *P* and *K*, Figs. 2, 6 and 7, the sand in the drag mold was carried through horizontally into the cope mold after the manner of the usual core print. The pockets for forming these prints are shown at *P* and *K* in the section of the drag pattern, Fig. 5. The flask is shown at *D* in Figs. 1 and 2. Fig. 1 is a cross section of Fig. 2 on line *L M N O*. *C* is the stripping plate, *B* the pattern plate, *G* the pattern, *E* the babbitt dead plate and *A* the hand stripper machine.

The cope stripping plate and the drag pattern plate are alike in outside size and shape and similar in outline where the pattern fits, except for the babbitt lined pockets *H*, *P* and *K* in Fig. 5 which correspond to the prints bearing the same letters in Fig. 2.

Machine the Patterns

Plenty of finishing stock was left for fitting to the contour of the pattern on both the cope and drag plates. After the plates were planed the cope pattern was adjusted in position and the outline scribed on the surface of the plate. It then was taken to a profiling machine where the contour was cut approximately to the line. The drag pattern plate then was clamped face to face with the cope plate and the pin hole and slot were machined. Plugs were driven in the openings to hold the plates in line when they were returned to the profiling machine to have the contour cut in the drag plate. This treatment insured a perfect match. The blocks *H*, *P* and *K* were prepared as separate pieces and up to this time had not been attached to the stripping plate.

A babbittt dead plate as shown at *E*, Fig. 1, was used to properly connect the pattern to the pattern plate. This is shown in greater detail in Fig. 8 in which A^1 is a section of the pattern while B^1 is one of the several brass hooks which were well soldered and riveted to the pattern. They were filed off on the bottom to bring the pattern to the exact distance required from the pattern plate. C^1 shows the stripping plate, D^1 the pattern plate, G^1 is one of a set of strips high enough to let the pattern A^1 into the stripping plate C^1 about 1/16-inch as at *L*.

The two plates C^1 and D^1 then were clamped in position with the wood strips G^1 holding them the required distance apart. They were held in alignment by pins inserted through the flask pin openings. The space at H^1 was stuffed roughly with cotton waste and then tightly sealed with clay as shown at I^1. A board was fitted roughly inside the pattern at J^1 and the joint with the pattern sealed with clay. The tapered block K^1 was fastened to J^1 in the position shown in Fig. 8. Screws E^1 were placed in holes in the pattern plate D^1 and were held in position by clay F^1 and extended almost to the pattern proper. The cavity *M* was filled with babbitt through the crack N^1 which extended all around the plate. The screws E^1 were painted with kerosene oil and lampblack to prevent adherence of the babbitt.

After the strips G^1 were removed and the plates mounted on the machines, the plate C^1 dropped down 1/16-inch in line with the bottom of the pattern at *L*. A little freeing up was required at *I*. Lampblack also was painted at the stripping plate contour at *L* for clearance.

Make Perfect Match

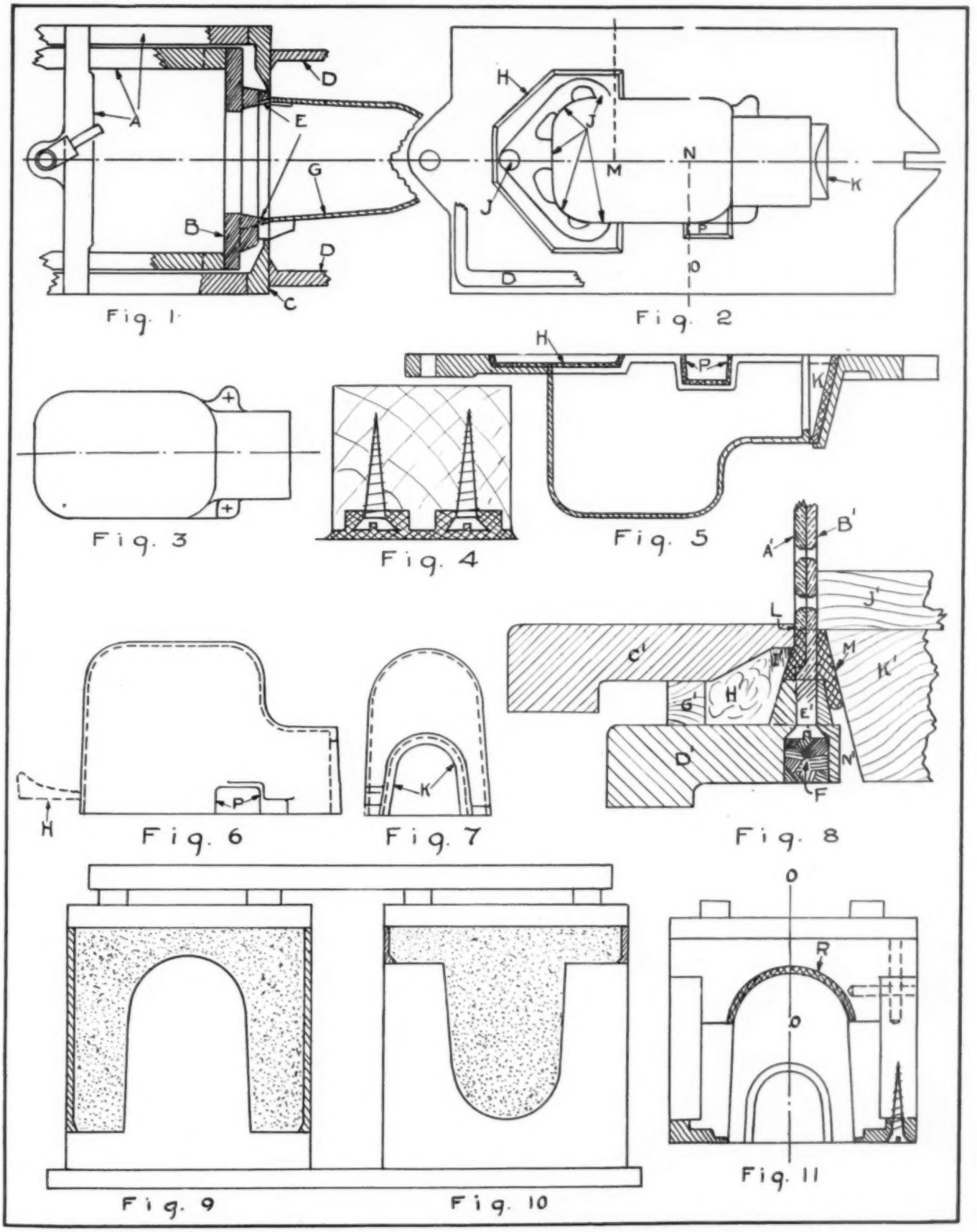
With the cope pattern mounted, the blocks *H*, *P* and *K* were fastened permanently in place. To make a perfect match the drag plate was placed over the cope pattern and the pockets *H*, *P*, *K*, Fig. 5, were poured with babbitt. As in the other instance, proper anchors were made, the joints clay sealed and the necessary surfaces painted with lampblack.

The drag plate then was removed and the drag pattern pressed into place. A wood frame well screwed and doweled together as shown in Fig. 11 was made to hold the drag pattern permanently in place. Several cross pieces in the form of saddles were introduced at advantageous points and poured with babbitt *R* to make a perfect fit. Fig. 4 shows an enlarged section of the saddle on the center line, showing how the babbitt is securely anchored to the wood saddles.

Attention is directed to the fact that in all the fitting, no matching was done by measurement, but all by

contact fitting of opposite halves which assured a perfect match throughout.

Another plan for molding castings of this type where there is plenty of draft is shown in Figs. 9 and 10, a cope and drag mold mounted side by side on the platen of a rockover jolt machine. Individual bottom boards are used and these are covered by a single board to which the rollover clamps are attached firmly.



FIGS. 1 AND 2 SHOW RESPECTIVELY A SECTIONAL AND A PLAN VIEW OF THE PATTERN MOUNTED ON THE PATTERN PLATE OF THE JOLT MACHINE. FIGS. 3, 4, 5, 6, 7 AND 8 SHOW VARIOUS DETAILS OF CONSTRUCTION REFERRED TO FULLY IN THE TEXT. FIGS. 9, 10 AND 11 ILLUSTRATE MANNER OF MOUNTING TWO SOMEWHAT SIMILAR PATTERNS ON A SINGLE MACHINE

This arrangement will not appeal to the casual observer at first glance. The two equalizer arms support the single board while the individual boards rest upon it as shown and therefore apparently are not properly equalized. However, we have several patterns mounted in this manner and have experienced little trouble with them.

Small Cupola Gives Good Results

By E. D. Soderstrom

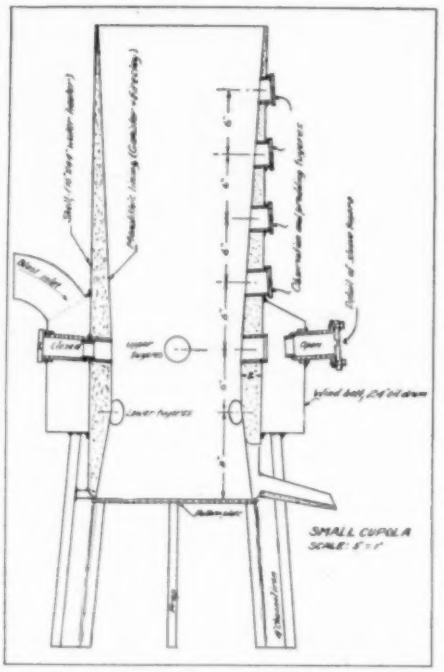
At various times descriptions of small cupolas have appeared in THE FOUNDRY. However, it is believed that one of the smallest—if not the smallest—cupolas in existence, was constructed and is in use in the division of engineering, Oklahoma Agricultural and Mechanical college, Stillwater, Okla. The accompanying sketch gives the dimensions and the table the data on one heat from this cupola.

The shell of the cupola is made from a section of galvanized water tank 16 inches in diameter and 44 inches long. The wind belt is a portion of a 24-inch oil drum which is welded to the shell. The cupola has eight tuyeres in two rows of four each. These tuyeres are pieces of 2-inch standard pipe and are welded to the shell. Four lower tuyeres constitute the regular blast entry and the area of these tuyeres equals 12 per cent of the cupola area at this section. The upper row of tuyeres is used mostly for observation and cleaning out.

Considerable trouble is encountered in small cupolas from bridging or hanging up. To eliminate some of this trouble, a series of observation and prodding holes are placed one above the other as may be seen in the sketch. This arrangement makes it possible to reach in with a bar and dislodge any hanging material. The cupola is open at the top which is advantageous in charging and keeping the charges going down properly.

It also assists in chipping out and cleaning after a heat. To faciliate these operations the cupola is laid on its side on two sawhorses. This allows repairing from both ends. To carry off the fumes and smoke, the cupola is placed beneath a ventilator when in use. Due to its small size, the coke and iron must be broken up. Coke works all right when broken into egg-size pieces and the iron which mainly is scrap, works satisfactorily when in pieces about 6 inches long.

Wind for operation is supplied from a 3½-inch line which supplies air to 20 forges and a larger cupola. In another small cupola constructed previously, the blast was supplied from a direct-connected, 2-fire, forge blower mounted behind the cupola. This made a portable outfit as the whole could be moved to any convenient source of electricity.



CROSS-SECTIONAL VIEW OF THE CUPOLA WITH DIMENSIONS

For purely instructional and experimental purposes, this small cupola is more satisfactory than the larger cupola because it costs but little to run. It can be run more frequently giving the students more practice in cupola operation and pouring. It serves to familiarize the students with hot iron before running the large cupola. Also it makes it possible to make needed small castings at any time when it is not convenient to operate the large cupola. Small quantities of iron of varying analyses may be melted for experimental or special purposes.

Association Will Consider Industrial Problems

Thursday and Friday, Aug. 16 and 17, have been designated as the dates for the annual meeting of the Ohio State Foundrymen's association which will be held at the Hotel Breakers, Cedar Point, O. The first session will be held at 1 p. m. Thursday. This session will consider many points referring to the workmen's compensation conditions as they affect the foundry industry of Ohio. Among the speakers will be Wellington T. Leonard, member of the Industrial Commission; T. M. Merriman, workmen's compensation insurance engineer; H. P. Sutherly, of the insurance department; and Fred G. Lange, special representative division of safety and hygiene of the Ohio Industrial Commission.

The annual banquet of the association which will be attended by members and their ladies, with invited guests will be served in the convention hall Thursday at 7 P. M. with a special entertainment program to be followed by a reception and dance.

The subject of merchandising foundry products will open the Friday morning session. This will be followed by an address on taxation by George B. Chandler, secretary of the Ohio Chamber of Commerce. A paper of particular practical interest to foundrymen, covering the subject of sand, will be given by H. W. Dietert, United States Radiator Corp., Detroit, closing the morning session. A series of round table luncheons for Friday noon will be headed by various speakers who are leaders in the subjects to be presented for discussion.

Cupola Heat Log for March 22, 1928

Charge No.	Coke—pounds	Iron—pounds	Fluorspar—ounces	
Bed	62	130 (auto scrap)		Fire started at 12:30 p. m.
1	7 to 9	45 to 50 (auto scrap)		Blast pressure on 2:40 p. m.
2	7 to 9	45 to 50 (pigged remelt)		Iron down 2:46 p. m.
3	7 to 9	45 to 50 (sprues and mach. scrap)	4	First stop off 2:50 p. m.
4	7 to 9	45 to 50 (sprues and mach. scrap)	4	Tap out every 4 minutes.
5	7 to 9	45 to 50 (sprues and mach. scrap)	4	Bottom dropped 3:25 p. m.
6	7 to 9	45 to 50 (sprues and mach. scrap	4	Blast pressure 2 to 3½ oz.
7	7 to 9	45 to 50 (sprues and mach. scrap)	4	Castings consisted of gear blanks, small machine parts and tractor lugs. All castings were OK.
Total	120	480	20	

The FOUNDRY Family Photograph Album

Upper Left

W. D. MOORE
American Cast Iron Pipe Co., Birmingham, Ala.

Lower Left

C. E. ANDREWS
Whitehead Bros. Co. New York

Upper Right

E. H. BALLARD
General Electric Co., West Lynn, Mass.

Lower Right

JOHN HOWE HALL
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

PROPOSED MASTER SPECIFICATION

For Copper-Nickel Alloy Castings

General Specifications

United States government general specification for metals, Federal specifications board Specification No. 339, in effect on date of invitation for bids, shall form part of this specification.

Grade

This specification covers one grade of copper nickel alloy in the form of castings.

Material

Material shall be as required in the following sections:

General Requirements

Castings shall be a copper nickel alloy, containing approximately 65 per cent nickel and 28 per cent copper, and shall be of uniform quality, sound, clean and free from blowholes, porous places, cracks or other defects that materially will affect their value for the purpose intended.

Detail Requirements

Chemical properties shall be as follows:

Copper minimum per cent	Nickel minimum per cent	Iron maximum per cent	Aluminum maximum per cent	Manganese maximum per cent	Carbon plus silicon maximum per cent
23.0	60.0	3.5	0.5	3.5	2.0

Physical requirements are as follows:

Tensile strength pounds per square inch minimum	Yield point pounds per square inch minimum	Elongation in 2 inches minimum per cent
65,000	32,500	25.0

Castings shall not be repaired, plugged or welded without permission from the purchaser. Such permission will be given only when the defects are small and do not affect adversely the machinability or use of the casting.

Responsibility of furnishing castings that can be laid out and machined to the finished dimensions of the article specified in the contract or purchase order, and shown on the finish drawings enumerated or referred to therein, shall rest with the contractor. Castings of excessive size or weight shall not be furnished, but sufficient stock shall be left to provide for all variations in shrinkage.

The surface of all castings shall be cleaned thoroughly before inspection by sandblasting, tumbling, chipping, or other approved process.

Castings not complying with all the requirements of this specification and of the contract or purchase order shall be rejected.

As presented by the United States government federal specification board, Washington.

(*Continued on Data Sheet No.* 728)

PROPOSED MASTER SPECIFICATION

For Copper-Nickel Alloy Castings

(*Continued from Data Sheet No.* 727)

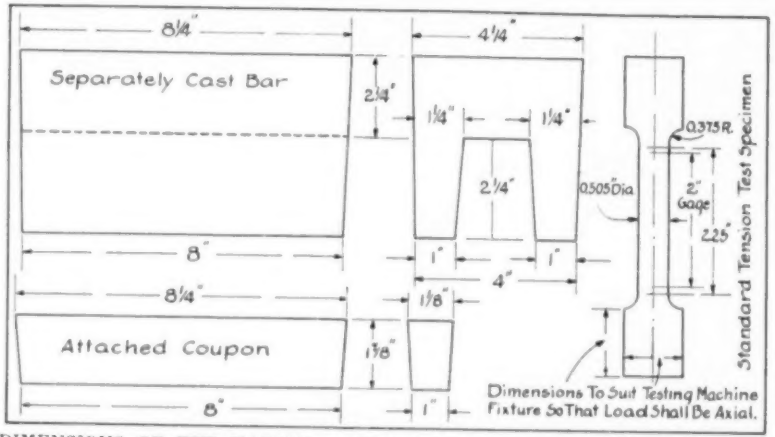
Material in which defects are revealed by machining operations shall be rejected. It shall be replaced by the manufacturer without expense to the purchaser.

Method of Inspection and Tests

An analysis of each melt or lot of castings shall be furnished by the contractor, showing the elements specified.

Check analyses of the castings may be made by the inspector, or through him by any government laboratory or other designated representative without cost to the contractor.

Drillings for check analysis of castings shall be taken from the test



DIMENSIONS OF THE VARIOUS TYPES OF TEST COUPONS AND OF THE STANDARD TENSILE STRENGTH TEST SPECIMEN

coupons or from representative castings selected by the inspector. The drillings shall be taken from sound metal below the surface.

Each casting weighing 250 pounds or more shall have at least one test coupon attached thereto. The responsibility of furnishing sufficient test material in all cases shall rest with the contractor.

In the case of castings weighing less than 250 pounds each, at least one test coupon shall be attached to one or more castings from each melt or heat of metal, or such groups of melts or heats as the purchaser may specify; but in no case shall a lot consist of more than 1000 pounds of castings.

(*Concluded on Data Sheet* No. 729)

THE FOUNDRY DATA SHEET, AUG. 1, 1928
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Metals and Melting

How Metallurgical Problems Have Been Solved in Gray Iron, Malleable and Steel

Tuyeres Become Black Early in Heat

Question: One hour after the first tap the continuous tuyere on our 60-inch cupola is choked with iron and slag that has frozen on the way down. We melt 35 tons of iron and semisteel a day and use 300 and 350 pounds of coke respectively on our 3000-pound iron and semisteel charges. The bed charge of coke is made up 2400 pounds. The tuyere is 5½ inches high and extends all around the cupola with the exception of a space 10 inches on each side of the slag hole. After two or three days the brick lining burns back within 1-inch of the shell at a point a little above the tuyeres and the entire melting zone has to be rebricked every two or three weeks.

Answer: We should like to have more particulars before offering a definite opinion on the unsatisfactory condition of the cupola outlined in your inquiry. For example you say the tuyere extends to a point within 10 inches of the slag hole on each side. Does that mean that the slag hole is as high as the tuyeres from the bottom? If this is the case you need not wonder that the slag freezes. The slag hole should be placed at least 3 inches below the tuyere line and every additional inch up to 8 is a help.

Basing our conclusion on your letter in general rather than on any one feature we are inclined to the opinion that you are not using enough coke. Theoretically the amount, 1 to 10, is correct, but circumstances alter cases and you are at present faced with a condition and not a theory. It may be that some other factor or combination of factors is responsible for your present trouble, but from your account it has all the earmarks of a cupola suffering from lack of fuel.

The amount you are using is sufficient for a short heat to be melted at maximum speed, but running a heat as you do for nearly three hours means that you will have to adopt a slightly different procedure. We suggest you raise the bed about 6 inches and add 50 pounds of coke to each charge. In fact you may find it advisable to add a double split of coke about the middle of the heat or at the point where your charges change from semisteel to gray iron.

The fact that the lining is burned away so badly right down to the tuyeres indicates that the melting zone gradually has dropped as the heat progressed. Also we suspect a high blast pressure.

Annealing Malleable

Question—What is considered the maximum allowable proportion of malleable scrap and steel in air furnace malleable? We also would like to know what are the proper silicon and carbon contents for castings of light to medium heavy weights, and the effect both on tensile strength and elongation, and on susceptibility to anneal, of increasing the total carbon to 3.00 and over, the silicon being reduced sufficiently to maintain a white iron? Finally, what should be the length of the annealing cycle?

Answer—Theoretically if you secure proper composition in malleable and melt correctly you could use an all-scrap mixture. However, this is found impractical and few, if any, firms use more than 60 per cent scrap in the air furnace. It is found difficult to secure the correct composition using a greater percentage than this, as the amount of sulphur becomes excessive, the carbon is apt to be too low, and the metal will tend to absorb an excessive amount of gases which will increase the shrinkage.

Carbon for light and medium weight castings is usually kept between 2.40 and 2.60 per cent while the silicon is maintained as high as possible without causing free carbon in the form of black spots to separate out in the hard iron. For lighter castings the silicon may run around 1 per cent, while for heavier castings it is usually necessary to keep the silicon below 0.8 per cent.

High carbon in malleable iron reduces both the tensile strength and the elongation of the iron, also, it tends to cause the iron to anneal quicker than if the carbon were low. It is impossible to give any definite annealing cycle for a malleable iron shop because this will depend upon how big the annealing oven is, and how close the pots are placed in the oven. The composition of the iron also will influence the annealing cycle. As a general thing it might be said that the oven is brought to temperature in about 36 hours and held at the temperature decided upon for from 60 to 70 hours. The annealing temperature of different shops varies from 1500 to as high as 1800 degrees Fahr. After the metal has been held at the annealing temperature for the decided length of time the oven is allowed to cool slowly to 1300 degrees Fahr. Some shops cool the oven at the rate of 5 degrees an hour, while others cool it as rapidly as 10 degrees an hour. When the temperature of 1300 degrees has been reached the rate of cooling gradually is increased, and when the pots are black they can be pulled out of the oven and dumped.

Makes Melting Pots

Question: We would like to know the analysis of a gray iron suitable for such work as pouring ladles for nonferrous metals and alloys. The iron should be such that it is not affected by molten nonferrous metals and alloys.

Answer: We do not quite understand your reference to cast-iron ladles used for the pouring of nonferrous metals. Probably you refer to melting pots used in melting aluminum, zinc and lead which generally are made of cast iron.

One car wheel company that makes this type of pot for melting as a sideline to its regular product, uses the regular mixture that is used for car wheels and claims good results. A car wheel mixture calls for 0.60 to 0.70 per cent silicon; sulphur, under 0.10 per cent; phosphorus, 0.30 to 0.40 per cent; manganese, 0.50 to 0.60 per cent. The pots manufactured are about 1 inch in thickness. If less than that the silicon will have to be raised. About 25 per cent charcoal iron is used in car wheel mixtures, and the scrap generally consists of old car wheels.

This iron will be white or almost so, and it generally is conceded that this type of iron is better able to withstand the effects of high temperature than ordinary gray iron. Sometimes the use of chromium additions is advocated. In this case increase the silicon and use about 0.50 to 0.75 per cent chromium.

Cleaning Room Progress Aids Production of Quality Castings

By Frank G. Steinebach

Part X

PICKLING is the term which has been applied to the industrial operation of removing dirt and scale from iron and steel objects with an acid bath. The process is utilized chiefly to prepare the surface of the metal for some form of protective coating. In the steel industry, pickling is used extensively to clean sheets, tin plate, strip, rods and pipe, and in the foundry, to a more or less degree to clean castings for enameling, galvanizing, painting, etc. As previously mentioned, a considerable tonnage of castings that formerly was cleaned and prepared for the protective coating by the pickling process, now is cleaned in one or more of the various types of sandblast equipment which have been described.

Scale, which is found on the surface of castings, consists largely of fused sand, the amount of scale depending on the chemical composition of the iron and the pouring temperature of the metal. Sulphuric acid, which is used extensively in pickling rolled steel products such as sheets, behaves rather peculiarly when brought in contact with the sand scale on the surface of the casting. Pure sulphuric acid has no effect on either the iron or the sand scale and dilute sulphuric, instead of eating away the scale, attacks the iron. In numerous instances, while the iron under the scale is dissolved to a more or less extent, the scale will not come off readily and the casting is in a worse condition than before the pickling process was started.

On the other hand, hydrofluoric acid reacts readily with sand and the scale formed by the fusion of the sand at the pouring temperature of the iron. Since hydrofluoric acid will attack and remove the sand and scale quickly without in any way effecting the metal, castings are pickled chiefly with that acid. Numerous solutions are used, one which has been recommended consisting of 1 part hydrofluoric acid, 1.2 parts of hydrochloric acid and 12 parts of water. This mixture would require approximately one 90 pound bottle of hydrofluoric acid, 12 gallons of hydrochloric acid and 120 gallons of water. It is necessary in pickling that the solution remain in a heated condition and in the mixture mentioned, a temperature of 130 degrees Fahr. is recommended, with about an hour required to complete the pickling operation.

Another solution consists of one part of hydrofluoric acid diluted with eight times its bulk of water. The castings may be allowed to remain in the bath any length of time after the sand has been eaten away, since the acid does not attack the iron. After the castings are removed from the hot pickling solution, they should be washed thoroughly in clean hot water. One disadvantage in this method of pickling is that the oxide scale will not be cleaned from the casting, but ordinarily there will be little oxide scale. However, if the castings have been partly machined and allowed to rust, or if they have acquired some oil or grease, it will be necessary to sand blast them before they can be pickled.

Other methods of pickling castings require a solution of hydrochloric acid diluted with three times its bulk of water, or a pickle of sulphuric acid diluted with five times its bulk of water. However, it is necessary to remove the castings from either of these solutions as soon as they are cleaned, and wash them in hot water, otherwise the acid will continue to eat the iron and cause undue waste of the acid and the metal. Castings sometimes are cleaned of scale with a solution of hydrofluoric acid and then placed in either hydrochloric or sulphuric acid solutions to remove the iron oxide scale.

After the castings have been in the pickling tank a sufficient length of time to remove the scale, the time depending upon the condition of the sand scale on the castings, they are removed from the hot acid solution and stored in steel or wood tanks filled with water, which prevents the castings from rusting until they are used. Where the castings are to be galvanized, they may be dipped for a short time into a hot hydrochloric acid solution before being placed in the zinc bath. A neutralizing solution also may be used to prevent the corrosive action of the pickling. Hydrofluoric acid has the disadvantage that it will attack the flesh, and for that reason rubber gloves should be worn by those working with the solution.

The strength of the pickling solution depends on the production requirements and the tank capacity. Where the production fluctuates, it is considered better practice to change the length of time that the pickling department is in operation rather than to reduce the tonnage going through in the same length of time. Years ago the strength of pickling solutions practically was a matter of guess, the experience of the operator being relied upon to gage the proper strength, but today the strength of pickling solutions usually are determined by analysis and the proper additions

then are made to secure the desired strength.

A wide variety of pickling equipment is used in the pickling process, the design depending upon the class of work to be pickled, the quantity of castings which may be cleaned and the method of procedure to be followed. A complete discussion of the design and construction of pickling tanks appears in a series of articles on "Practical Features of Pickling" by Wallace G. Imhoff which appeared in *Iron Trade Review*, 1928. He states that pickling tanks are constructed of many different materials of which wood, including cypress, yellow pine, white pine and fir, are the most common. The wood tank may be lined with lead which is carried up the sides, over the top and down the outside for about a foot. The lining is burned together with oxyacetylene and all sharp corners in the tank are rounded.

Steel tanks are used for water rinse tanks and for alkali solutions, the most common use for that type of tank being found in the enamel industry. A special rubber lined steel tank, with all pipes and valves equipped with the rubber lining, is used to store muriatic acid, and concentrated sulphuric acid is stored in steel tanks. A few stone tanks still are in service. The search for new materials for the construction of pickling tanks led to the use of acid-proof brick laid with acid-proof cement. Concrete pickling tanks lined with lead or with special acid proof brick or paving block also are in use. The shell is made of 6 to 9-inch reinforced concrete set on heavy timbers or I-beams painted with acid-proof asphalt.

According to Mr. Imhoff, cleaning solutions may be held in wooden or steel tanks; water wash solutions, both hot and cold, in wooden or steel tanks; sulphuric acid solutions in plain or lead lined wooden tanks, lead lined concrete tanks or acid-proof brick tanks; muriatic acid in wooden or acid-proof brick tanks; nitric acid in acid-proof brick tanks; hydrofluoric acid in wooden tanks and alkali washes, such as lime, soda, etc., in steel, wood or concrete tanks. Size and shape of the tanks depend largely upon the requirements of the industries in which the tanks are used. Pickling tanks are round, square, oval and rectangular.

Construction of pickling tanks varies. Tanks for small light articles usually are made of cypress dovetailed between joints and painted or sealed with red lead, white lead, rubber or acid-proof cement. Tie rods, nuts and washers are made of acid-resisting alloys or bronze. Heads are countersunk and the cavity packed with grease or an acid-proof asphalt or cement. The bottom of the tank is protected from wear by a layer of bricks and the tops are protected by cypress planks nailed or bolted with copper spikes or bolts.

Small tanks may be heated with an open steam line or a closed lead or copper pipe system. A common method is to have a rubber hose connection, a copper or lead pipe, an acid-proof nipple or a common steel nipple arranged to pass steam directly into the tank. The chemical action which takes place during the pickling operation causes gases to be generated. Since these gases usually are obnoxious and of a corrosive character, the pickling department usually is located in a separate building or far enough removed from other departments in the building so that damage will be avoided. Fumes are allowed to escape through windows, and in some cases fans are provided to assist in carrying off the gases. Several types of inhibitors are used to reduce the amount of gas produced. One type of inhibitor forms a heavy foam on the surface of the pickling solution, thereby reducing the acid fumes; another type does not form a foam but retards the action of the acid, and a third forms a foam and also retards the action of the acid.

Various types of equipment are used to dip the castings into the pickling solution. These include hooks, bars or pipe which hold the castings or numerous hooks which in turn support the castings, chain for heavy castings, hangers or baskets. Again, the type of equipment is governed entirely by the type of casting which must be handled in and out of the pickling tank and the water or alkali tank. In one foundry making cylinder castings for the textile industry, which was described in the Feb. 1, 1923 issue of THE FOUNDRY, the castings were taken to the cleaning room by a trolley hoist. There they were lowered into a long shallow trough filled to a depth of about 3 inches with a pickling solution. Each casting in turn is rolled from one end of the vat to the other, the surface of the casting being submerged about 25 times during the operation.

Will Build Foundry

International Petroleum Co., Ltd., 56 Church St., Toronto, Ont., Canada, is inquiring for proposals on a complete gray iron foundry, gas or electrically operated for installation in Colombia, South America. The average monthly production required is 2000 pounds of babbitt metal, 26,900 of cast iron and 2100 pounds of cast brass. These requirements represent the minimum, rather than the maximum capacity. L. E. Bury, purchasing agent, asks for proposals in duplicate.

FIG. 91—SEMIAUTOMATIC DEVICE USED FOR PICKLING. FIG. 92—CASTINGS MAY BE CARRIED TO THE TANKS IN BASKETS

Committee Reports
Progress on Coke Specifications

Outline of Investigation to Date Is Presented, Also a Tentative Series of Tests Is Recommended as a Basis for Specifications

By W. A. Selwig

PROBABLY the first organized effort to formulate standard specifications for foundry coke was made in 1905 when the American Society for Testing Materials appointed a committee for the purpose. Shortly afterward the scope of the committee's activity was enlarged to include blast furnace coke. In 1915 this committee in collaboration with committees from the American Chemical society and the American Foundrymen's association presented methods for coke analysis which were accepted as tentative standards and published as such in the *Proceedings* of the American Society for Testing Materials, Part 1, 1916, pp. 551-563.

These methods include the preparation of the laboratory sample and the determination of moisture, ash, volatile matter, fixed carbon (by difference) sulphur and phosphorus. In 1918 the society accepted these methods as standard.

Preparation of these standard methods represented a distinct step forward. Many of the determinations are empirical and require careful standardization to be of value in specifications. Standard methods of analysis now are recognized generally as satisfactory and should be used in specifications covering the analysis of foundry coke. They have been revised from time to time and were adopted as standards in 1927 by the American Society for Testing Materials. They may be consulted in *Standards* of the American Society for Testing Materials, 1927, Part II, pp. 709-720.

In 1915 the coke committee presented tentative specifications for foundry coke. These were accepted later as standards and have been incorporated in *Standards* of the American Society for Testing Materials in Part II, pp. 524-526, under the heading "Standard Specifications for Foundry Coke." These specifications cover the method of sampling, preparation of the sample for analysis and limits of chemical composition.

Each carload of coke, or its equivalent, is specified as a unit for sampling. A sample of not less than one cubic foot is taken from the exposed surface. Pieces approximately the size of a walnut are broken with a hammer from the exposed surface of the coke in a manner calculated to yield an average indication of the contents of the car. Specific directions are given for crushing and reducing the sample to not less than 5 pounds for transportation to the laboratory. Directions are given for collecting a special moisture sample.

Dry coke shall not exceed the following limits in chemical composition:

Constituent	Per cent
Volatile matter	Not over 2.0
Fixed carbon	Not under 86.0
Ash	Not over 12.0
Sulphur	Not over 1.0

Purchaser shall have the option of deducting moisture in excess of 3 per cent from weight of the coke, provided the car is weighed at the time of sampling.

Method of collecting a cubic foot gross sample does not represent good sampling procedure. Good sampling would require the collection of a much larger gross sample taken at regular intervals while unloading the coke. The committee recognized this fact but justified the method for several practical reasons: (1) Crushing and reduction of several hundred pounds of coke necessitates the use of a mechanical crusher, seldom available at the point of sampling. (2) Sampling while unloading the coke is feasible only when the coke is purchased under a system of premiums and penalties. According to the experience of the committee, the trade was not willing to accept this system at that time (1915). It seemed essential to take the sample from the exposed surface so that the carload could be rejected before unloading if the coke did not conform to specifications. Coke that fails to conform to the limits of chemical composition will be rejected and the shipper notified within five working days from the date of sampling.

Specifications state that in case of dispute, an independent chemist, mutually agreed upon, shall sample and analyze the coke, the cost to be borne by the party at fault. The resample shall be taken and prepared as prescribed before, except that the minimum quantity of gross sample shall be not less than one bushel in volume, taken at intervals of 18 inches on six equidistant lines parallel to the side of the car.

Collecting samples from the exposed surface of a car would appear to be satisfactory only in sampling homogeneous substances, but coke hardly can be considered in that class. Chemical analyses based on nonrepresentative samples often are worse than useless, as they are misleading. Some experimental coke sampling should be conducted to obtain information showing how analyses of sam-

Will Take Time

THIS article is from a paper presented before the Philadelphia convention of the American Foundrymen's association, May 14-18, 1928. The author, W. A. Selwig, is assistant chemist, Pittsburgh station, United States bureau of mines, and secretary of committee D-5 on coal and coke, American Society for Testing Materials. On account of the gradual change taking place over a period of years in the coke situation, the committee working on the subject found it necessary to pursue investigation along new lines including a proper method of securing samples and a clearer understanding of what conclusions are to be drawn from chemical analysis, and what is required in the way of physical tests. A study of the behavior of coke under service conditions it is hoped will form the basis of a set of specifications which will give a positive assurance to the purchaser that whatever he does with the coke, satisfactory results are possible where the specifications have been met.

ples collected by this method compare with analyses of samples collected by taking large gross samples of several hundred pounds as the car is unloaded.

A number of foundry coke specifications are listed on pages 102-103 in the *National Directory of Commodity Specifications*, 1925, issued by the bureau of standards. For comparative purposes, the limits of chemical composition of these specifications are given in the accompanying table.

One of the specifications given in the table is that of a large manufacturer, eight are those of railroad companies, and one is that of the navy department. These specifications are almost similar in regard to chemical composition, which indicates that there should be no special difficulty in getting various companies to agree to the same specifications. Only two of the specifications have a limit for phosphorus content. One limits phosphorus to a maximum of 0.025 per cent, the other to 0.05 per cent. Some of the specifications state that the pieces shall be large with as little breeze as possible; others that the coke shall contain no fines or breeze. Two specifications state that practically none of the coke shall pass through a 2-inch ring; another that all shall be retained on a 2½-inch screen.

Blast furnaces have been and now are operated successfully on coke in which physical characteristics differ widely from the common conception of what should constitute good furnace coke. This is true also in the operation of a cupola and good results may be obtained with coke of varying physical properties provided the foundryman learns how to use it to best advantage. The foundryman should select the best coke available, without imposing any needless requirements which would tend to reduce the oven output or seriously affect the gas and by-product yield. The coke producer naturally is limited in the coals economically available to him for cokemaking. Character of the coke produced largely depends upon the type of coal charged into the ovens. These points are presented for consideration, as the problem of coke specifications should be approached without prejudice.

Coke may be light or heavy, porous or dense, soft or hard, brittle or tough, weak and friable, massive, blocky pieces or small fingery pieces full of checks. The committee has standardized and is standardizing methods of physical testing in most common use for metallurgical coke. Such testing is empirical and to be of value it is necessary that the methods be carefully standardized if the results are to be used in determining how the various physical properties of coke affect its performance in actual use. If we can correlate the results of physical tests with the useful properties, we can approach the question of specifications with some intelligence.

Limits of Composition

Company designation	Maximum volatile matter	Minimum fixed carbon	Maximum ash	Maximum sulphur	Maximum moisture
A.S.T.M	2.0	86.0	12.0	1.0	3.0
1	2.0	86.0	12.0	1.0	1.5
2	2.0	.....	12.0	1.0	0.5
3	2.0	87.0	10.0	1.0	....
4	....	.....	12.0	1.0	....
5	2.0	.....	12.0	1.0	....
6	1.3	.....	11.0	0.8	....
7	2.0	.....	12.0	1.0	....
8	1.0	85.8	10.0	1.3	2.0
9	1.0	85.8	10.0	1.3	2.0
10	3.0	86.0	12.0	1.0	....

Porosity value usually varies from 40 to 60 per cent. The average is about 50 per cent. Specifications of the navy department 7C2a, Coke, March 1, 1927, for foundry coke require not less than 50 per cent by volume of cell space.

Porosity is calculated from the apparent specific gravity of the moisture-free lump coke and the true specific gravity of moisture-free coal pulverized to pass a 200-mesh sieve. It is usually computed as follows:

$$\text{Percentage of cell space} = 100 - 100 \frac{\text{Apparent specific gravity}}{\text{True specific gravity}}$$

See *Standards* the American Society for Testing Materials, 1927, Part II, pp. 574-578.

True specific gravity is the specific gravity of the carbonaceous material and inorganic matter making up the cell walls. Apparent specific gravity is the specific gravity of the coke substance plus the cells. Metallurgical cokes usually show a true specific gravity ranging from 1.8 to 2.1, and an apparent specific gravity of 0.8 to 1.15.

True specific gravity is influenced by the coking temperature, rank of coal and percentage of ash. Some believe that the combustibility of coke increases as the true specific gravity decreases.

The shatter test was designed to measure the mechanical strength of coke and should indicate the probable breakage of coke on handling. The test has been standardized and is used considerably in testing blast-furnace coke. A 50-pound sample of coke is dropped four times from a height of 6 feet upon a cast iron or steel plate. The material then is screened to determine breakage.

In *Industrial and Engineering Chemistry*, Vol. 14, 1922, pp. 926-941, Kinney and Perrott report an investigation of the test, using a wide variety of coke. They recommend that several tests be made and the results averaged. The average probable error of a single shatter test determination is approximately 2 per cent. Shatter-test values for a number of different by-product and beehive cokes, based on the percentage remaining on a 2-inch screen, showed a range from 42 to 77 per cent. The navy foundry-coke specifications state that the weight of coke remaining on a 2-inch screen after being subjected to the shatter test shall not be less than 70 per cent.

Tumbler or Hardness Test

The tumbler test has been used to some extent in testing furnace coke to determine the relative resistance of the coke to mechanical attrition in the blast furnace. A 25-pound sample of 2-inch to 3-inch coke is placed in a steel drum and the drum usually is revolved 1400 times at a rate of 24 revolutions per minute. At the end of the test the amount of breakage is determined by passing the coke over various screens. The so-called hardness factor is usually taken as the percentage of original sample remaining on a ¼-inch screen. The breakage in the machine apparently is caused by both impact and abrasion. Perrott and Kinney tested seven different cokes by this method and found that the hardness values ranged from 70.6 to 77.5 per cent, a total range of only 7 in a value whose probable error of a single determination is approximately 1. The authors concluded that the test did not give any new or additional information on physical properties not shown by the ordinary shatter test.

Proceedings, American Society for Testing Materials, Vol. 27, Part I, 1927, pp. 497-498 shows methods of test for cubic-foot weight of coke and for sieve analysis of coke. In determining the cubic-foot weight, a box 24 x 24 x 24 inches inside dimension is used. The method of sieve analysis

specifies square-mesh sieves with openings up to 4 inches. The weight per cubic foot depends on the apparent specific gravity of the coke and on the size and shape of the coke pieces. The lighter the coke and the smaller the size, the more surface will be exposed per unit weight, which will affect the combustibility of the coke in the cupola. The property of reactivity, or combustibility of coke, is beyond the scope of this paper and has been discussed in many published papers. The reactivity with CO_2 varies with different cokes, and further work may show that this test is a measure of a property of coke of considerable importance.

Committee D-5, American Society for Testing Materials, has agreed to form a subcommittee on foundry coke specifications; this subcommittee to serve as a joint committee with a committee on foundry coke specifications of the American Foundrymen's association. Any other desirable organizations will be asked to appoint representatives. The joint committee on foundry coke specifications will include men familiar with foundry practice, methods of coke testing, and the prepartion of the proper specifications.

Present standard specifications for foundry coke are old and may require a good deal of revision. The committee has suitable methods of chemical analysis and has standardized and is standardizing various methods of physical testing. If the various tests of physical properties of cokes can be successfully correlated with performance in the cupola, is seems logical to suppose that specifications covering simple requirements of chemical composition and physical properties can be put into specifications which will cover various grades of coke available for foundry use.

Identify Impurities by Simple Tests

BY T. G. BAMFORD

THE term scrap brass embraces a great variety of metals and alloys, good, bad and indifferent. The best include commercially pure copper, old bronze bearings and chips from machine shops where high grade alloys are machined. At the bottom of the list are old door knobs and similar cheap fittings, originally made from inferior materials. Sometimes scrap brass is not sorted when it reaches the foundry and it is impossible to make an analysis of every lot. Scrap should be graded and a fracture of a piece often furnishes a reliable guide to composition.

Manganese bronze, aluminum brass and high zinc alloys are used where strength is required. Bearings rarely are made of these alloys. Bearings usually consist of copper and tin, and copper-tin-lead mixtures. While classification of color of fracture into red, yellow and white brass normally serves as a reliable guide to the copper and zinc content, it must be noted that alloys like manganese bronze have a whitish close-grained fracture closely resembling the copper-tin alloys.

The various impurities likely to cause difficulty in remelting scrap brass are those elements previously added for the purpose of removing the oxides, adding fluidity or conferring special properties on the alloy. The chief impurities are iron, aluminum, phosphorus, silicon and lead. Iron present in red brass, forms small nodules of exceeding hardness, causing much trouble in machining. These hard spots blunt tools, necessitating regrinding with consequent loss of time and expensive tool steel. When present in small quantities in yellow brass, the iron is not segregated, and merely acts as a hardener without injuring tools. It is added intentionally to certain alloys, but the alloys are difficult to machine and sometimes cause complaints. Iron filings, chippings, etc., may be detected with a magnet, and if the metal is hard when filed, the presence of iron in the alloy may be assumed. A black scaly appearance of castings made from scrap metal is a sure indication of considerable iron.

Aluminum is undesirable in scrap metals, as the formation of aluminum oxide makes the castings unsound. Small quantities of aluminum produce a characteristic sheen on the surface of the castings, an undesirable feature in bronze castings. The presence of aluminum can be detected by hard grinding on an emery wheel. Aluminum brass or bronze will heat greatly, burr over at the sides and abrade slowly.

Phosphorus in brass scrap is not generally disadvantageous. Silicon is not a suitable deoxidizer for brass or bronze, or for any alloy containing lead as it causes excessive drossing due to the formation of lead silicate. Alloys containing much lead are heavy, and they may be tested by indentation with a hammer. Smaller percentages may be detected by making an ingot from the scrap and drilling it.

If the metal contains lead, the chips will break and the ingot will drill fairly easily, but if the chips are curly the stock contains no lead. Copper scrap such as commutator segments frequently contains silicon, and in case of doubt a trial heat of sand castings should be run of some alloy containing a considerable quantity of lead. If the proportion of silicon is likely to be injurious, the castings will show inclusions of white powdery dross.

Iron may be removed by adding copper oxide to the melt. Aluminum when present in small amount also may be removed by copper oxide. This is not practical in high zinc brass, because the zinc is removed with the aluminum. In straight aluminum bronze the copper oxide should be mixed with salt, but eight pounds of oxide are required to remove one pound of aluminum. Silicon in copper scrap may be removed by adding copper oxide and a little salt. Scrap received from outside sources should be graded and stored in iron boxes properly covered and marked. Chips or turnings if mixed with iron should go to the magnetic separator to remove particles before melting.

Clean chips may be melted down or briquetted and used to advantage directly in brass foundry operation. The chips are placed in the bottom of the pots occupying about 1/5 of the crucible, and the ingots are placed on top. The zinc in the chips acts as a deoxidizer, much of it being volatilized and condensed on the surface of the ingots, thus preventing them from being oxidized as they become heated. The practice is found useful in preventing porosity, and it is further effective if a tablespoonful of salt is placed on the top of the chips before adding the copper. It is a good plan to reduce the small scrap to briquets, lessening the losses in melting, simplifying transportation to the furnace and facilitating the charging operation. The greater the zinc content the greater the need for briquetting.

In crucible and furnace melting of yellow brass, the losses run from

8 to 15 per cent, but where turnings alone are melted the loss is reduced from 2 to 5 per cent if the turnings are briquetted. The electric furnace has reduced metal losses to low figures, which briquetting cannot greatly improve. It is important to remove oil and to soften by annealing, for which the rotary dryer serves a useful purpose.

In regard to pouring, an important question is the gas absorption. Sulphur dioxide has a tremendous reactivity upon brass, and if a lot of scrap brass is heated in a coke furnace the sulphur in the coke probably will form sulphate of copper oxide, which wastes the copper and probably produces unsound and unsatisfactory castings. But if the copper is heated up to 1200 degrees Cent., it removes the sulphur dioxide, and it is possible to remove that completely by maintaining a higher temperature. Hydrogen regularly is absorbed in large quantities. It naturally would be expected that the higher the temperature the greater the contraction, but on account of the gas question it usually is found that the intermediate temperature gives greater contraction than pouring at a high temperature.

Heavy Chill Is Required for Tire Casting

Question: We have some tires to make for clay working machinery, 48 inches inside diameter, 12 inches deep, 3 to 3½ inches thick and will appreciate information on the following points: What thickness of metal is required in the chill; what should be the position, number and size of the gates; Should the chill be painted and if so with what material; Is it necessary to heat the chill to any definite temperature before pouring the mold.

Answer: We know of no rule by which the thickness of the chill may be determined from the thickness of the casting. So many factors are involved that the final choice in nearly every case simply represents the opinion of the maker and this opinion, in turn, is based on experience and knowledge of the iron in his district. For example ingot molds 3 inches thick withstand successfully an average of 150 heats of steel in which the body of steel may be almost 2 feet in cross section. Chills for car wheels usually are 5 inches thick, although the rim of the wheel is not much more than 1 inch in thickness. Chills between 5 and 6 inches thick are used for making roller tires and we doubt if any thinner chills would be satisfactory.

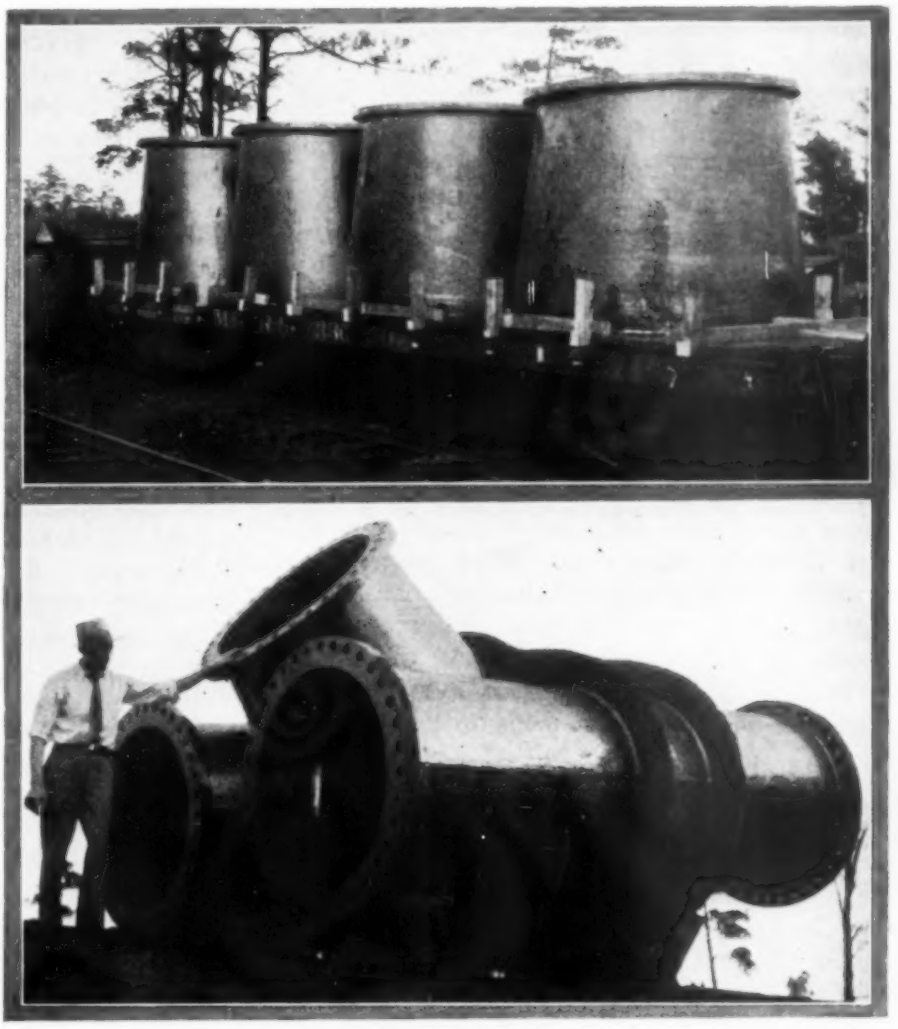
To prevent waves on the face of the casting, also to promote uniform heating of the chill and subsequent cooling of the casting, the mold should be filled rapidly from many points. In your case we suggest 12 runners 2 x ½-inch set 12 inches apart on a center line on the upper rim. Instead of setting them perpendicularly, set them at an angle of approximately 60 degrees so that as the metal rises in the mold it will be given a tangential movement. The runners are fed from a circular basin.

Chills are placed in the core oven over night and when they are removed in the morning they are coated with a plumbago wash applied lightly with a camels hair brush. They are only slightly warm when the casting is poured. The only object in heating the chill is to effectually dispel any moisture. Chills are made from a low sulphur, low phosphorus iron.

Use Alloy Steels

The tendency to use alloy steel on railroad equipment was reflected at the recent railway equipment exhibition at Atlantic City. For instance a Canadian Pacific nickel steel driving box casting was show whose weight was 15 per cent less than that of the ordinary steel casting for the same purpose. The use of alloy steel, it was pointed out, saves in weight and cuts down the dead load, thus enabling the railroads to pull a proportionately greater amount of revenue freight.

Southern Foundry Completes Unusual Junction Casting Job



ONE of the most difficult castings ever made in southern foundries was finished recently at the plant of the Bessemer Foundry & Machine Co., Bessemer, Ala. This is a special casting to form the junction of several large mains, to be installed in a sewage disposal plant in the Chicago district. The "junction" as it is shown in the above illustration weighs 23,000 pounds. The company also cast the four large septic vats, shipped to Chicago.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ What Is High Test Iron?

IN PRESENTING his report as chairman of the American Society for Testing Materials committee A-3 on cast iron, recently, R. S. MacPherran mentioned that the committee had under consideration the increase of physical limits on so-called, high-test cast iron. For the past several years, the feeling has been prevalent among iron foundrymen that some of the lack of confidence in their product might be due to the specifications covering cast iron and that other classification termed, for want of a better adjective, *high-test* cast iron.

PROBABLY few foundries would ever have any difficulty meeting the transverse requirements running from 2500 to 3300 pounds, depending upon the class of casting and determined by center loading a 12-inch length of the standard bar. Similarly, the tensile test, seldom a factor of real importance in iron castings is given as 18,000 to 24,000 pounds per square inch. In 1924 a second classification previously referred to as *high-test* cast iron was proposed with a 3800-pound transverse and 28,000-pound per square inch tensile requirements. Many foundries daily produce metal, which in the test bar will give higher results, and still they are judged by this inadequate adjective *high-test* and their product is damned beyond redemption by all designing engineers to whom they hope to sell their castings.

GENERAL descriptive terms as applied to quality are dangerous. Witness the esteem formerly possessed by that variety of poultry produce labeled *fresh* eggs. At one time the buying public accepted such as the best that could be obtained from the provisioner. Then came *strictly fresh* eggs, something else again, and a reproach on the variety labeled merely fresh. Again *guaranteed strictly fresh* added another gradation and still further retired into the realms of doubtful virtue the eggs which were merely fresh. Today, the housewife looks askance at all alike discredited by an overindulgence in superlatives, a stigma of age and more or less of the stigma of cold storage attaches even to the best of eggs.

IS IT beyond reason to fear a similar result in continuing this terminology of *high-test?* Already some castings manufacturers have found the adjective inadequate as applied to their product and for this and other reasons have taken refuge in trade names, descriptive trademarks and other means of setting their castings ahead of mere cast iron or even high-test iron. Further, would not some wider variation be permissible, a grading into several classifications all capable of being examined by test and all adapted to the needs of some particular services. Perhaps the numbering or initialing of various grades might be better.

¶ Decline the Invitation

RECENTLY, a malleable foundry encountered a serious complaint from a customer because of shrinks appearing in practically all castings made from a certain pattern that was furnished by the buyer. Attention was drawn to correspondence in which the foundry had protested the way in which the pattern was gated, and particularly the inadequacy of the gating area to provide proper feeding. Permission to make the necessary pattern changes, at the customer's expense had been refused.

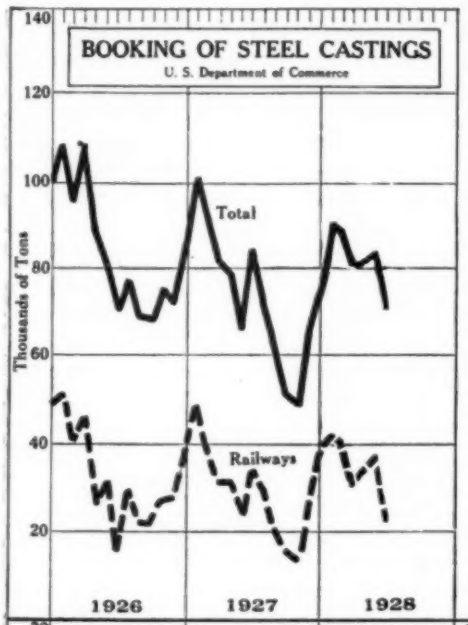
UNDOUBTEDLY, if the pattern was at fault, the foundry should have declined to continue to use it, but under present competitive conditions, it is probable that some other shop would have taken the work in event of such refusal. This would have resulted in losing at least a portion of the work of the customer, but it is probable that the ultimate result would have been in favor of a firm refusal. Better to lose a job than to attempt to make it in a way which will result in failure and the impairment of a foundry's reputation for quality.

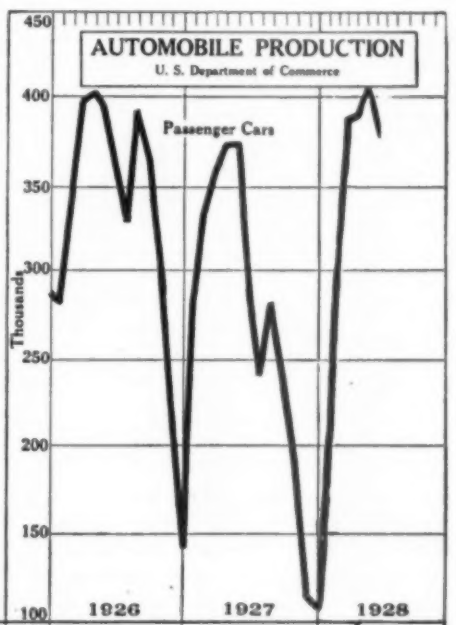
Trade Trends in Tabloid

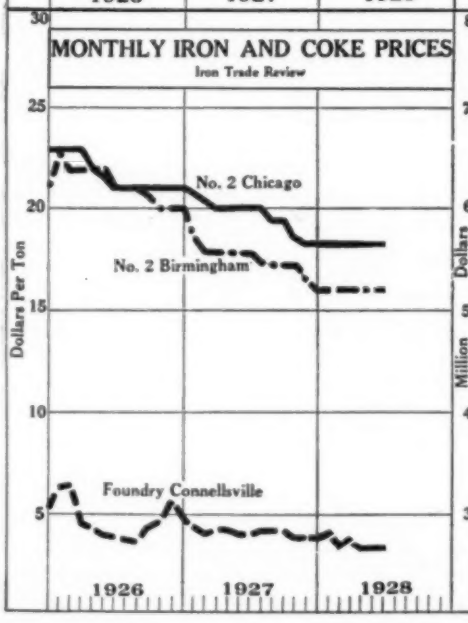
SUPPORTED by a number of unusual factors, foundry operations, which often encounter a severe summer slump, are holding a high average rate. Jobbing foundry business still is spotty, with some shops working full time and with a fair backlog of orders, while others are slack. Automotive demand is continuing to provide ample orders, in gray iron, steel and malleable lines. The latter in particular are busy on automobile castings and slightly better prices exist. Manufacturing establishments that operate their own foundries are experiencing varied fortunes. One or two machine tool builders have closed their foundries and are buying their requirements. On the other hand an eastern foundry making laundry machinery, textile and special equipment for the rayon industry is booked for capacity operation for a year ahead. Railway purchases still are slack and recent compilations show that of a total of 28,334 freight cars ordered during the first six months of the year, 4528 or 16 per cent are being built in the railway company's own shops. Brass foundries in general are operating at 65 to 85 per cent of normal, supported largely by plumbing goods demand. Farm machinery plants are busy and expect 1928 to surpass all previous records since the war. Building contracts, car awards, employment figures and wage payments all show an upward trend during June and July.

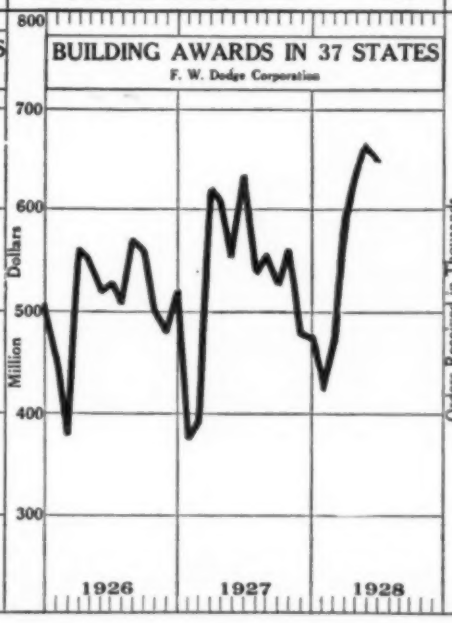
RAW MATERIAL PRICES
July 21, 1928

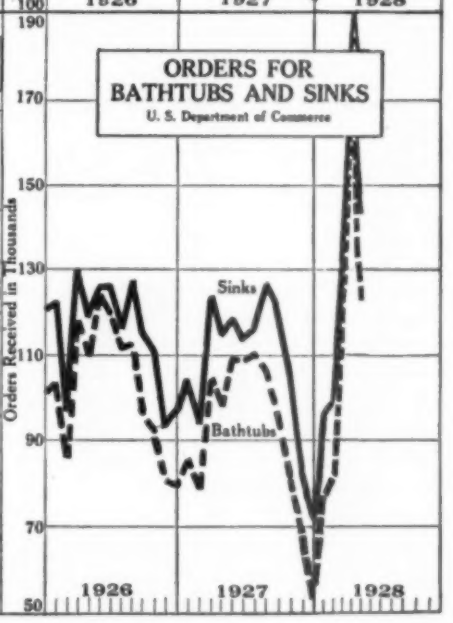
Iron	
No. 2 foundry, Valley	$16.50 to 16.75
No. 2 southern, Birmingham	15.50
No. 2 foundry, Chicago	17.50
No. 2 foundry, Philadelphia	20.26 to 20.76
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.00
Basic, Buffalo	17.00
Malleable, Chicago	17.50
Malleable, Buffalo	17.50
Coke	
Connellsville foundry Coke	$3.50 to 4.50
Wise county foundry coke	5.00 to 5.25
Scrap	
Heavy melting steel, Valley	$14.00 to 14.25
Heavy melting steel, Pitts	13.50 to 14.00
Heavy melting steel, Chicago	12.50 to 13.00
Stove plate, Buffalo	13.00 to 13.50
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	14.25 to 14.75
No. 1 cast, Philadelphia	16.00
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Birmingham	14.00 to 14.50
Car wheels, iron, Pittsburgh	14.00 to 14.50
Car wheels, iron, Chicago	13.00 to 13.50
Railroad malleable, Chicago	12.50 to 13.00
Agricultural Mal., Chicago	11.75 to 12.25
Malleable, Buffalo	15.00 to 15.50
Railroad malleable, Pitts	13.75 to 14.00
Nonferrous Metals	Cents per pound
Casting copper, refinery	14.37½ to 14.50
Electro copper, producers	14.75
Straits tin	47.50
Lead, New York	6.20
Antimony, New York	9.37½
Nickel, electro	37.00
Aluminum, No. 12 producers	23.00
Aluminum, No. 12, remelt	16.00
Zinc, East St. Louis, Ill	6.20











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

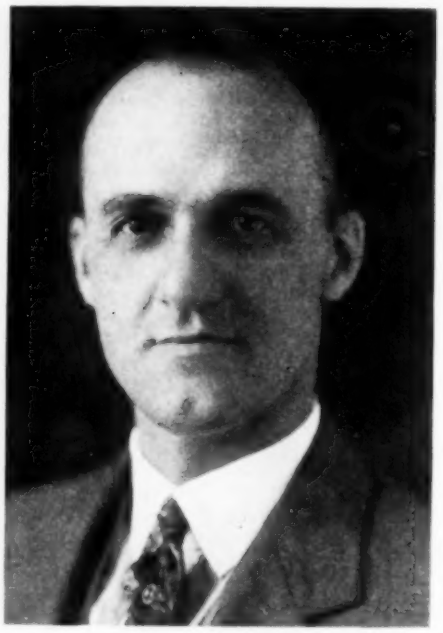
H COLE ESTEP, vice president, The Penton Publishing Co., Cleveland, publisher of THE FOUNDRY and other technical and business publications has been elected a director of the American Foundrymen's association to fill the vacancy left by the resignation of W. D. Goldsmith, C. A. Goldsmith Co., Newark, N. J. Mr. Estep who was born at Stampede Tunnel, Washington, in 1886, was educated in the public schools and was graduated from the University of Minnesota, Minneapolis, in 1908. Previous to that time he had been employed with the engineering department of the Northern Pacific railway. He joined the editorial staff of The Penton Publishing Co. in 1908 as assistant to R. T. Kent, engineering editor. From 1908 to 1910 he represented the company in Seattle, Wash., removing to Chicago in 1910 where he was in charge of editorial work until 1914. In 1914 he was transferred to Cleveland as associate editor of THE FOUNDRY and *Iron Trade Review*, and during the war he was editor of *Marine Review*, from 1915 to 1919. In 1918-19 he was editorial director. Mr. Estep was sent to London in 1919 as European manager, returning to take up executive duties in Cleveland in 1924. He is a member of the American Foundrymen's association, American Iron and Steel institute, American Society of Mechanical Engineers, British Iron and Steel institute, Institute of British Foundrymen and Association Technique de Fonderie de France. He has been active in the work of the American Foundrymen's association since 1914; was editor of the *Transactions* and chairman of the papers committee, and at present is chairman of the committee on international relations, the group which has initiated and fostered the exchange of papers on foundry subjects between the American Foundrymen's association and European technical societies. He also is secretary of the Foundry Equipment Manufacturers' association.

F. W. Seiblin, formerly with Lees-Bradner Co., now is with the Hill Clutch Machine & Foundry Co., Cleveland, as manager of the machine division.

A. W. Lewis has been appointed acting resident manager in charge of the Cleveland works and sales office of the United States Cast Iron Pipe & Foundry Co., Burlington, N. J.

Henry P. Blumenauer, Arcade Malleable Iron Co., Worcester, Mass., has been made chairman of an organization committee for the formation of a Founders' council in that city.

W. C. Raithel, Mound City Foundry Co., has been elected vice president of the St. Louis District Foundrymen's club instead of A. G. Kaiser as announced in the July 1 issue of THE FOUNDRY on page 535.



H. COLE ESTEP

J. J. Seaver, vice president of Arthur McKee & Co., engineers, Cleveland, and for 15 years a member of the company, also formerly president of Pulaski Foundry & Mfg. Corp., has become vice president of H. A. Brassert & Co., Chicago, engineers. Mr. Seaver has contributed to THE FOUNDRY on sales subjects.

C. W. Nixon, superintendent of the Central Foundry Co., Bessemer, Ala., has been appointed assistant to M. J. Maloney, general manager of the southern plants of the company, and vice president and general manager of the Central Iron & Coal Co., headquarters to be at Holt, Ala.

L. D. Hood, assistant superintendent at the Bessemer foundry, has been promoted to superintendent.

F. J. Walker, of the Davies & Thomas Co., Catasauqua, Pa., spoke on the foundry industry before members of the Northampton Exchange club at their weekly meeting in the Allen House, Allentown, Pa. After reviewing the history of the foundry industry in a general way, Mr. Walker told of the work accomplished by the Davies & Thomas company in furnishing the segments for the tunnels under the Hudson and East rivers in New York.

W. C. Greer has been made foundry foreman for the Dayton Bronze Bearing Co., Dayton, O. Mr. Greer formerly was connected with the Railway Supply & Equipment Foundry Co. and later the Epping Carpenter Co., both of Pittsburgh. He served his time with the United Engineering & Foundry Co., Pittsburgh and the Wheeling Mold & Foundry Co., Wheeling, W. Va. In the latter instance he worked under J. D. Miller, at present superintendent of the Cresson-Morris Co., Philadelphia.

A. F. A. Plans Spring Meeting in Chicago

At a meeting of the board of directors of the American Foundrymen's association held in Chicago, July 16, it was unanimously decided that the next annual convention will be held at the Hotel Stevens, Chicago, during the week of April 8, 1929. At that time it is planned that the extensive exhibit facilities of the hotel, embracing over 32,000 square feet of space will be used for limited showing of non-operating exhibits, while the technical sessions and committee activities will center in the various meeting rooms of the hotel.

The new officers and directors, whose election was announced during the Philadelphia convention, took office. One of the most important actions taken at the meeting was the decision to appoint an educational committee, charged with the responsibility of assembling and spreading knowledge of castings and their uses; this committee will be formed from representatives of the several branches of castings manufacture, the equipment industry and the business press. The recommendation of the committee on cast iron, involving participation with the Engineering Foundation on the summarization of information on cast iron, was referred to a special committee to be appointed by the president.

A. J. Tuscany to Manage Gray Iron Institute

Arthur J. Tuscany, of Cleveland, was chosen manager of the Gray Iron institute at a meeting of the executive committee of that organization held in Cleveland July 17. The election marks the completion of the roll of permanent officers to head this newly formed organization. Dan M. Avey, editor of THE FOUNDRY, Cleveland, has been serving as temporary secretary of the institute since its formation.

Members of the executive committee are the president, Walter L. Seelbach, Forest City-Walworth Run Foundries Co., Cleveland; the following vice presidents, B. L. Johnson, Cresson-Morris Co., Philadelphia, and A. E. Hageboeck, Frank Foundries Corp., Moline, Ill.; the treasurer, H. S. Chafee, Builders Iron Foundry, Providence, R. I.; and J. L. Carter, Barlow Foundry Co., Newark, N. J.

Mr. Tuscany has been prominently identified with the Ohio State Foundrymen's association as secretary and manager since 1922. He was formerly associated with the Whitney Tractor Co., Cleveland, the Post Tractor Co., later consolidated with the Whitney company, and the Johns-Manville Corp., New York, in executive capacities.

The Gray Iron institute was organized at a meeting called for that purpose at Philadelphia, May 18. At that time some permanent officers and an executive committee were elected. A constitution and by-laws,

ARTHUR J. TUSCANY

resulting from a meeting in Pittsburgh on March 13, at which time the resolution for organization was presented, were adopted.

The formation of the Gray Iron institute is the outgrowth of efforts to unite the industry in a co-operative campaign to promote its interests and develop new markets and uses for gray iron.

Obituary

Charles H. Trowbridge, president, Duffy-Trowbridge Stove Mfg. Co., Hannibal, Mo., died at his home in that city Monday, July 9.

J. Andrew Strauch, purchasing agent of the National Bearing Metals Corp., St. Louis, died in that city. Mr. Strauch was born in St. Louis and was educated in the public schools there. His father, John B. Strauch, is president of the company which employed him at the time of his death.

Maj. Joseph A. Steinmetz, 59, an inventor of antiaircraft devices and a pioneer in the development of aviation in this country, died July 11, at his home in Germantown, Philadelphia, after a long illness. Major Steinmetz organized the engineering firm of Janney, Steinmetz & Co., Philadelphia, retiring from that company about six months ago because of ill health. During the war Major Steinmetz served as a member of the national research council. He was a member of numerous engineering and technical societies.

Foundry Association Directory

American Foundrymen's Association

President, S. T. JOHNSTON, S. Obermayer Co., Chicago; secretary-treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings on third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, DAVID G. ANDERSON, Western Electric Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at Webster hall, Cass and Putnam avenues, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, CHARLES F. MILLER, Universal Winding Co., Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smond avenue, Toledo, O.; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, W. P. Bradley, Wheeling Mold & Foundry Co.; secretary-treasurer WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, A. D. MATHESON, French & Hecht, Davenport, Iowa; secretary-treasurer, HUGO WOLF, Frank Foundries Corp., Davenport, Iowa. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

Washington Foundrymen's Club
Seattle

President, RONALD KUCHER, Olympic Foundry Co., Argo Station, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

REFRACTORY CLAY AND GRAPHITE ARE USED

Introduces Ladle Nozzle

The Joseph Dixon Crucible Co., Jersey City, N. J., recently has introduced a new combination ladle nozzle. The upper half of this nozzle is made of a highly refractory clay and the lower half is built of graphite. The feature claimed for this nozzle is that the metal may leave the ladle at a lower temperature than ordinarily is the practice, thus avoiding difficulties in pouring the ingot. Low pouring temperatures are possible due to the heat retaining quality of the graphite in the lower half of the nozzle. The new nozzle is made in any size to vary with the flow hole required.

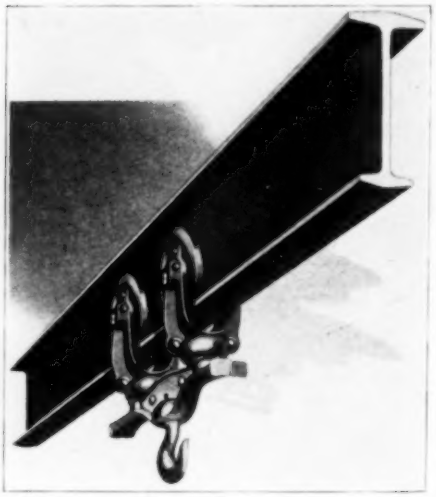
Compressor Supplies Air

A semi-portable, single stage, double acting, multiple belt driven air compressor, for use where air requirements are comparatively limited, recently has been introduced by the Pennsylvania Pump & Compressor Co., Easton, Pa. The motor, starter, multiple belt drive, air receiver, air filter and automatic start and stop control all are assembled before shipment, forming a compact unit occupying a small amount of floor space. Air cylinders and all working parts are lubricated automatically. A hopper cooling tank may be supplied with the compressor if desired.

The unit is equipped with air cushion valves and contains many of the features which are built into the line of compressors manufactured by that company. The unit is equipped with a 10-horsepower, high torque motor operating the compressor at a speed of 400 revolutions per minute. The pistons displace 65 cubic feet of air and the automatic pressure control operates between 85 and 125 pounds. The same construction also is used in a two-stage type of compressor for pressures from 125 to 250 pounds.

Monorail Track Rolled with Heavy Section

The Louden Machinery Co., Fairfield, Iowa, recently has introduced a heavier line of monorail track which has a rated carrying capacity of 3000 pounds. This new overhead trolley track is of a special section, approximately 6 inches deep, with a 3-inch flange at the top and a 2-inch flange at the bottom. The upper flange provides a gripping surface for the supporting hangers, while the lower flange constitutes the track for the twin trolley wheels. The beam is rolled with a special form for service as a trolley track. Special features also distinguish the new 2-way, 3-way, cross-track and turntable switches designed for use with this track system.



A 3-INCH FLANGE IS PROVIDED AT THE TOP AND A 2-INCH FLANGE AT THE BOTTOM

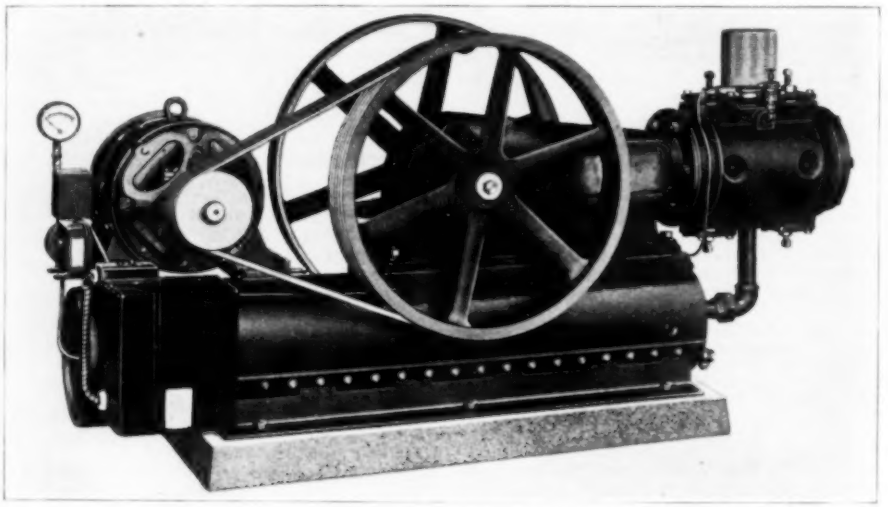
The new track not only has the advantage of handling heavy loads, but it eliminates to a large extent the necessity of supporting superstructure. It also is claimed that the hangers may be spaced widely, thus saving time and minimizing the expense of erection. The new track will not supersede the monorail system with double bead track which has been marketed for a number of years by the Louden Machinery Co., but will be an addition to their line of conveying equipment. The new type of track may be used alone or in conjunction with the lighter double bead monorail.

Change Firm Name

The Derwent Foundry Co. (1920), Ltd., of Derby England, manufacturer of lawn mowers and specialists in light repetition work, has changed its name to Qualcast Ltd., and from a private company it now has become a public one.

The company was incorporated as a private company on Jan. 24, 1920, under the title of the Derwent Foundry Co. (1920) Ltd., and at that time it acquired the ironfounding business of the Derwent Foundry Co. Ltd. The business has been in existence for well over 100 years, having been established in 1801 by the great-grandfather of the present chairman and managing director, John E. V. Jobson.

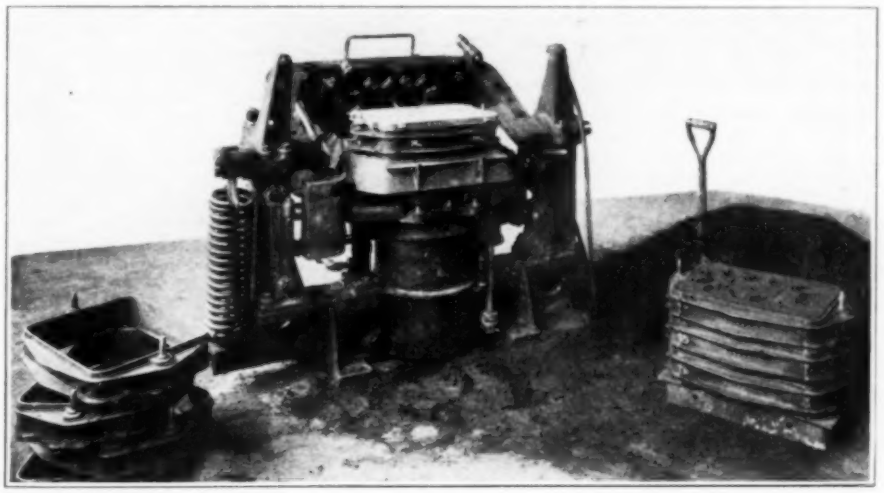
The company's trademark is registered in Great Britain, the Irish Free State, Australia, New Zealand, South Africa, France, Belgium, etc., and specializes in the manufacture of lawn mowers and precision iron castings of various kinds, particularly for the motor, electrical trades, etc.



COMPACTNESS IS A FEATURE OF THE COMPRESSOR DESIGN

Head Operates by Power

The Tabor Mfg. Co., 6225 Tacony street, Philadelphia, has introduced a new multiple molding machine of the jar-strip squeeze type. While this machine follows the standard split pattern practice of the Tabor company as far as possible, several interesting changes in design have been included. Perhaps the principal features of the machine are the type of swinging yoke used and the method of insuring alignment between the upper and lower head during the squeezing operation. The head is operated by power, thus relieving the operator of this operation. The guides which may be noted in the accompanying illustration, guide the two heads in all directions and may be adjusted easily. The drawing speed and vibration operation are entirely automatic on the machine.



SPECIAL PROVISION HAS BEEN MADE TO KEEP THE UPPER AND LOWER HEAD IN ALIGNMENT DURING THE SQUEEZING OPERATION

Sand Cutting Machine Has Screen Attachment

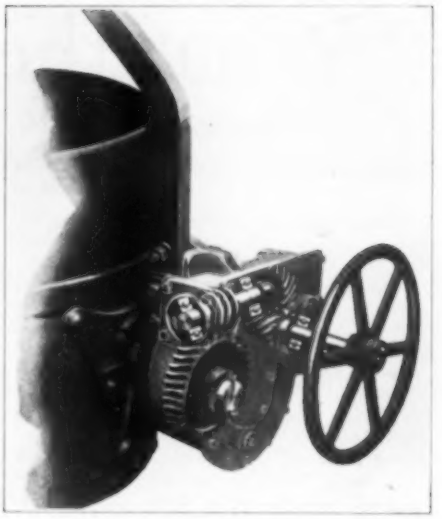
The American Foundry Equipment Co., Mishawaka, Ind., recently has produced a new type of sand preparing machines, which screens, aerates, cuts and piles sand in one operation. As may be noted in the accompanying illustration, screening is accomplished in one operation by cutter blades throwing the sand through a screen, while aeration takes place as the sand falls to the floor. Contamination such as tramp iron, lumps of sand, etc., is removed from the sand heap by the screen and is carried to one side of the heap of the shute shown in the illustration.

The screening unit is an integral part of the machine and is operated in connection with a standard cutting cylinder. The screen has a mechanical hoist which lifts it out of the way and over the machine proper. In that position the screen is not used and a plain sand cutting machine with sand and cutting cylinders is available for plain cutting and piling operations. The screen attachment is a vibrating unit which riddles the sand through a combination of ¾ and ½-inch mesh wire screen.

It is claimed that sand passed through this screen is equivalent in quality to sand cut three or four times with a plain cutting cylinder due to the disintegrating action of the screen. It is also claimed that a considerable increase in strength is secured through the mulling action of the sand passing through the screen.

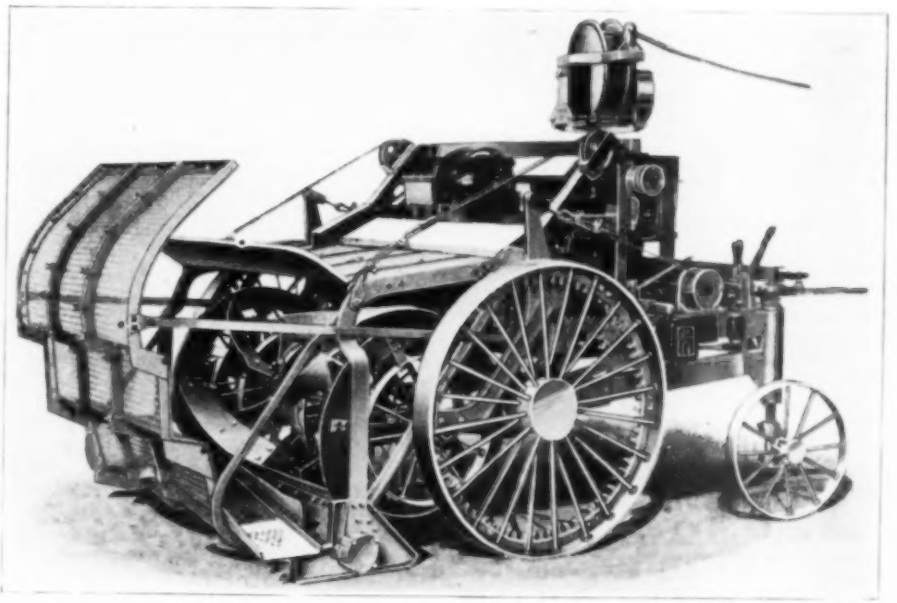
Gears Run in Oil Bath

The Whiting Corp., 15607 Lathrope avenue, Harvey, Ill., recently has made several changes in the design of its line of helical-worm geared ladles. These changes include the introduction of ball bearings, as may be noted in the accompanying illustration, and the use of an oil-tight, cast-steel housing. The cast-steel housing has been introduced to eliminate any difficulty which may arise from the high temperature to which the ladles are exposed and from the sand and grit encountered in the foundry operations. The housing permits the gears to operate in an oil bath, similar to that used in the construction of cranes, which prevents dirt from reaching the gears and simplifies the lubrication problem.



A CAST STEEL HOUSING PREVENTS DUST FROM REACHING THE BEARINGS

The Grays Harbor Iron & Machine Works, Aberdeen, Wash., and the Lamb Machine Co., Hoquiam, Wash., have been merged under the name of Lamb-Grays Harbor Co. The general offices of the company will be located at Hoquiam, Wash.



THE CUTTING CYLINDER THROWS THE SAND THROUGH THE SCREEN IN THE REAR

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Brass & Aluminum Products Co. Inc., Newport, Ky. has been incorporated by Theodore Reynolds and O. Burbank.

Hiner Supply & Mfg. Co., Raleigh, N. C. plans to rebuild its foundry and machine shop damaged in a recent fire. (Noted May 15).

Caldwell-Watson Foundry & Machine Co., Birmingham, Ala. plans to rebuild its burned building at 1300 Fifth avenue.

Millbury Steel Foundry Co., Milbury, Mass., C. T. Lund, president, plans to build a 1-story power plant, 60 x 100 feet.

Kewanee Boiler Corp., Kewanee, Ill. has awarded the general contract for a 1-story plant addition, 80 x 270 feet.

C. S. Card Iron Works Co., 2501 West Sixteenth street, Denver, plans to build an addition to its machine shop.

Texas Electric Steel Casting Co., Houston, Texas, has purchased an electric furnace which will be installed in its new foundry.

Delco-Remy Corp., Anderson, Ind., has a large force engaged in the construction of its new foundry building.

Shenango Foundry Co., Sharon, Pa., has completed the repairs on its foundry which was damaged by fire.

The Commercial Steel Castings Co., Marion, O., recently was merged with the Osgood Co., also at Marion.

Clark Equipment Co., Buchanan, Mich., will build an addition to its plant which will provide 45,000 square feet of additional floor space.

Black-Clawson Co., Hamilton, O., recently has completed a new addition to its plant. This structure is 60 x 80 feet and cost $60,000.

Central Foundry Co., Dundalke, Md., W. Dingeldein, superintendent, is building a plant addition for the manufacture of cast iron pipe fittings. The plant will be 1-story.

Packard Motor Car Co., 1580 East Grand boulevard, Detroit, has awarded the contract for a 1-story foundry addition to E. Winters Co., 1650 East Grand boulevard.

L. Christiansen Co., Lynn, Mass. has been incorporated with $100,000 capital to engage in foundry and machine shop business, by Anna M. Hill, 34 Moulton street.

Simpson Foundry & Engineering Co., Newark, O., recently has moved into the buildings formerly occupied by the May-Fiebeger Furnace Co.

Brandon Stove Co., Little Rock, Ark., is rebuilding part of its plant that was damaged by fire recently. The building will be 4 stories high and constructed of steel and concrete.

J. I. Case Threshing Machine Co., Racine, Wis., has purchased the plant and inventory of the Emerson-Brantingham Corp., Rockford, Ill.

Hubbard Steel Foundry Co., East Chicago, Ind., recently has equipped its open-hearth furnaces with an automatic draft control. The firm also has installed two new core ovens.

Homestead Valve & Mfg. Co., 134 Sixth avenue, Stoops Ferry, Pa., has awarded the general contract for a 1-story foundry addition, 50 x 50 feet. (Noted July 1.)

Waterbury-Farrell Foundry & Machine Co., 453 Bank street, Waterbury, Conn. has awarded the contract for a 2-story plant to Immick Co., State street. (Noted July 15).

Hunt-Spiller Mfg. Co., 383 Dorchester avenue, South Boston, Mass. has awarded the general contract for a 1-story, 45 x 75-foot addition for the manufacture of gun iron castings.

Pontiac Foundry & Machine Co., Pontiac, Mich. recently incorporated with $75,000 capital by C. D. Forester and George R. Fink, has opened its plant in the Howard Foundry building.

Buckwalter Stove Co., Royersford, Pa., has purchased the equipment and rights for an electric stove from the Simplex Wire & Cable Co., Cambridge, Mass., and will manufacture it at its plant. It is expected that 50 or 60 men will be added to the firm's payroll.

Plano Foundry Co., Plano, Ill., recently has been reorganized, and the new officers are, C. B. McGrath, president, treasurer and general manager, and J. D. Harris, secretary. The new officers expect to remodel the foundry to conform to the latest methods in production.

Chevrolet Motor Co., Flint, Mich., has let contracts for construction of a gray iron foundry unit at Saginaw, Mich., to cost $4,000,000, of which $700,000 is for equipment. The foundry will have a melting capacity of 1700 tons a day.

Williams Alloy Products Co., Elyria, O., plans a $50,000 expansion program which will include an additional building and new furnaces which will give the firm a capacity of 50 tons of metal a day. Plans for the expansion are in the hands of James H. Herron & Co., Cleveland.

Duplex Mfg. & Foundry Co., Elyria, O., owned and operated by the Lakewood Engineering Co., Cleveland, is building a plant addition which is expected to be ready for occupancy soon. The firm manufactures brass and bronze castings, street drainage goods and brick clamps.

Oakland Motor Car Co., Pontiac, Mich., has begun excavation work on its new foundry unit which will be adjacent to the recently completed Oakland and Pontiac factories. Six buildings will comprise the foundry unit and will include a core room, a cupola building, sand storage building, cleaning department and a service building. The group will have a total of 200,000 square feet of floor space. The foundry will have a capacity of 450 tons a day and mechanical equipment will be used as much as possible. It is estimated that 700 men will be employed when the foundry is running full.

New Trade Publications

SAND-HANDLING EQUIPMENT—An interesting bulletin on conditioning sand has been issued by the C. O. Bartlett & Snow Co., Cleveland. It describes a typical system of sand handling and conditioning, as developed by this company. It begins at the shakeout and proceeds to the screens, the magnetic separator, pug mill, blender, aerating bin, distributing system and the point of use.

ROLLER BEARINGS—Hyatt Roller Bearing Co., Newark, N. J., has inaugurated a picture tabloid, printed in sepia by rotogravure. The first issue covers a number of installations of the company's roller bearings in industry. A minimum of printed word carries the pictures, which tell their own story.

MOTOR STARTERS—Allen-Bradley Co., Milwaukee, manufacturer of electric controlling equipment, has issued a bulletin on one type of its starters. Numerous illustrations are used.

HIGH TEMPERATURE CEMENT—A current bulletin by the General Refractories Co., Philadephia, is devoted to its cement for refractories used under high temperature. Analysis of the cement, reasons for its resistance and methods of testing are included.

CUPOLA—Whiting Corp., Harvey, Ill., has issued a bulletin on a new cupola. This includes many of the features of the cupola produced for years by this company, with new features designed for more efficient service. Diagrams and specifications are included.

ELECTRICAL DEVICES—General Electric Co., Schenectady, N. Y., has issued bulletins on a number of items of equipment, as follows: Enclosed magnetic switches, drum-type controllers, gas engine-driven arc welder, temperature overload relay panel, low-speed synchronous generator, constant-potential arc welder, centrifugal air compressor, multi-speed induction motor, arc welder, mechanical drive turbine, remote-indicating speed controller, fan-cooled induction motor, arc welding equipment, and speed regulating rheostats.

OVERHEAD CARRIERS—Modern Pouring Device Co., Port Washington, Wis., has issued a catalog on its overhead carrier systems and metal pouring equipment. It covers hand traveling cranes, monorail systems, jib and wall cranes.

HERRINGBONE GEAR—Palmer-Bee Co., Detroit, has published a 48-page catalog describing its line of herringbone gears and herringbone and mill-type spur gear speed reducers. It contains tables of horsepower ratings, dimensions of standard size units, a list of advantages claimed over open drives and instructions on installation and lubrication.

FLASKS—Slip flasks, adjustable jackets and snap flasks are described in a recent bulletin of the Osborn Mfg. Co., 5401 Hamilton avenue, Cleveland. Special features of construction are presented in an interesting manner.

MAGNETIC CLUTCHES—The Magnetic Mfg. Co., Milwaukee, has issued an 8-page folder describing the construction and operation of its line of magnetic clutches. Horsepower, rating and dimensions of the clutches are included in the folder.

OXY-ACETYLENE EQUIPMENT—Oxweld Acetylene Co., New York, has issued a 56-page catalog, describing in detail products manufactured by this company, including welding and cutting equipment of all sorts, and generators for the production of acetylene. New items described are a new type cutting blowpipe, low pressure acetylene generators and floodlights. The publication is illustrated.

WIRE ROPE SLINGS—John A. Roebling's Sons Co., Trenton, N. J., has issued an 85-page catalog describing its wire rope slings. Illustrations show some of the recent developments of wire rope slings as substitutes for other lifting apparatus. Charts show the various safe loads for the slings, under different conditions. The catalog has numerous pictures showing the wire rope slings in actual use.

STORAGE CUPBOARDS—Van Dorn Iron Works, Cleveland, in a folder issued recently, displays several of its various types of storage cupboards. The folder, which is illustrated, explains in detail the size of each cupboard.